October 8, 2004

10 CFR 54

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Stop: OWFN P1-35
Washington, D.C. 20555-0001

Gentlemen:

In the Matter of	)	Docket Nos. 50-259
Tennessee Valley Authority	)	50-260
		50-296

BROWNS FERRY NUCLEAR PLANT (BFN) - UNITS 1, 2, AND 3 LICENSE RENEWAL APPLICATION – RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION (RAI) DEVELOPED DURING THE LICENSE RENEWAL AUDIT INSPECTIONS FOR COMPARISON TO GENERIC AGING LESSONS LEARNED (GALL) DURING WEEKS OF JUNE 21, 2004 and JULY 26, 2004 (TAC NOS. MC1704, MC1705, AND MC1706)

By letter dated December 31, 2003, the Tennessee Valley Authority (TVA) submitted, for NRC review, an application pursuant to 10 CFR 54, to renew the operating licenses for Browns Ferry Nuclear Plant, Units 1, 2, and 3. As part of its review of TVA's license renewal application, the NRC staff performed license renewal corporate inspections during the weeks of June 21, 2004 and July 26, 2004 for consistency to Generic Aging Lessons Learned (GALL) comparison and identified areas where additional information is needed to complete the review.

The specific areas are from several sections of the GALL comparison inspection affecting such disciplines as Mechanical Electrical, Civil, In-service Inspection (ISI), Licensing, and Chemistry. During these license renewal audits, TVA maintained informal NRC questions in a license renewal database and through discussions between TVA and the NRC; certain questions were selected by the staff as requiring formal TVA response.

The enclosure to this letter contains the specific NRC requests for additional information and the corresponding TVA response.

If you have any questions regarding this information, please contact Ken Brune, Browns Ferry License Renewal Project Manager, at (423) 751-8421.

I declare under penalty of perjury that the forgoing is true and correct. Executed on this 8th day of October, 2004.

Sincerely,

Original signed by:

T. E. Abney
Manager of Licensing
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Enclosure:
cc: See page 3

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ENCLOSURE

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT (BFN)
UNITS 1, 2, AND 3
LICENSE RENEWAL APPLICATION (LRA),

RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION (RAI) FROM GALL COMPARISON INSPECTIONS DURING JUNE AND JULY 2004

(SEE ATTACHED)

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT (BFN)
UNITS 1, 2, AND 3
LICENSE RENEWAL APPLICATION (LRA),

RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION (RAI) FROM GALL COMPARISON INSPECTIONS DURING JUNE AND JULY 2004

As part of its review of TVA's license renewal application, the NRC staff performed license renewal corporate inspections during the weeks of June 21, 2004 and July 26, 2004 for consistency to Generic Aging Lessons Learned (GALL) comparison and identified areas where additional information is needed to complete the review. The specific areas are from several sections of the GALL comparison inspection affecting such disciplines as Mechanical, Electrical, Civil, In-service Inspection (ISI), Licensing, and Chemistry. During these license renewal audits, TVA maintained informal NRC questions in a license renewal database and through discussions between TVA and the NRC; certain questions were selected by the staff as requiring formal TVA response. This enclosure contains the specific NRC requests for additional information and the corresponding TVA response.

Question 136

LRA Section B.2.1.4

NRC Issue

Aging Management Program Evaluation: ASME Section XI Subsections IWB, IWC, and IWD Inservice Inspection Program, Rev. 0, 12/31/03 (TVA Document No. B44 040105 075), p. 17, "Parameters Monitored/Inspected" identifies ASME Section XI Tables IWB-2500-1, IWC-2500-1, or IWD-2500-1 to develop the program and schedule.

The applicant also indicates that current approved relief requests and approved code cases are used. The staff notes that these are not applicable to the extended period of operation. The applicant is asked to verify that their commitment to implement the requirements of 10 CFR 50.55a for License Renewal is NOT in any way modified by the current relief requests or implementation of currently approved code cases.

TVA Response

The commitment to implement the requirements of 10 CFR 50.55a for License Renewal is not modified by the current relief requests or implementation of currently approved code cases. In general, relief requests expire at the end of each inspection interval. There are currently no relief requests which extend past the 40 year period. Use of NRC approved Code Cases is not considered a modification of our commitment to implement 10 CFR 50.55a. 10 CFR 50.55a allows the use of NRC approved alternatives. Any relief requests which might extend into the renewal period, or any new relief requests, as well as any approved Code Cases will be implemented in accordance with 10CFR50.55a and will therefore satisfy those requirements.

Question 144

LRA Section n/a

NRC Issue

A number of existing AMPs currently implemented for Units 2 and 3, will be enhanced to include Unit 1 in the scope of the AMP. The applicant's commitment for implementation is "prior to the period of extended operation".

The applicant is requested to clarify whether implementation on Unit 1 will commence with unit restart. If this is not the case, please provide the technical justification for delaying implementation of these AMPs.

TVA Response

The BFN License Renewal Application ensures structures and components requiring aging management review are adequately managed for the period of extended operation with the AMP commitments for implementation stating: "prior to the period of extended operation." NRC approval is required for the restart of BFN Unit 1 and TVA will comply with the Current Licensing Basis (CLB) and Regulatory Requirements at restart. AMPs required for BFN License Renewal that are also required to comply with the CLB for Unit 1 at restart will be in place at restart (i.e. Flow-Accelerated Corrosion Program, Open-Cycle Cooling Water Program, Closed-Cycle Cooling Water Program).

Question 147

LRA Section B.2.1.4

NRC Issue

With reference to Unit 1, what is the IWB/IWC/IWD commitment for re-start baseline inspections, after restart, and during the extended period of operation? Will inspections still be in accordance with 1974 edition through the 1975 addenda for Unit 1? Or will all 3 units be inspected to the same code edition? The staff notes that the inspection sample size for Class 2 is 7.5% in the 1974 edition through the 1975 addenda, and 15% in the 1995 edition through the 1996 addenda.

TVA Response

Current code editions:

Unit 1 Code of Record 1974 Edition Summer 75 Addenda (for selection)

Unit 2 Code of Record 1995 Edition 1996 Addenda

Unit 3 Code of Record 1989 Edition

NDE Code of Record for all 3 units 1995 Edition 1996 Addenda

For the period of extended operation the Code edition will be consistent with 10CFR50.55a requirements.

SURVEILLANCE INSTRUCTION 1-SI-4.6.G, INSERVICE INSPECTION PROGRAM UNIT 1, is an administrative Surveillance Instruction (SI) utilized to obtain data through nondestructive examinations (NDE) required by ASME Section XI.

Section 1.4.1 of this SI provides the following with regard to the edition and addenda used for nspections.

The Preservice Inspection (PSI) code of record for Unit 1 recovery, beginning with revision 2 of this procedure, is the 1995 Edition with Addenda through 1996 of ASME Section XI for Class 1, 2 and 3 components including their supports.

Repaired or replaced components will receive a preservice examination in accordance with the requirements of IWB, IWC or IWD of the component being repaired or replaced and prior to returning the system to service.

The re-baseline inspections will be performed on the remaining Class 1, 2 and 3 components that have not been repaired or replaced. The inspection of the selected components will be performed in accordance with the percentages specified below and IWX-3000 inservice acceptance criteria from the 1995 Edition through the 1996 Addenda of ASME Section XI will be used:

Class 1

- 25% of piping welds accessible without removal of supports or permanent plant features for those systems not being replaced
- 100% component supports
- RPV vessel head and longitudinal shell welds, relief is required
- 100% Bolting
- 100% accessible RPV interior and interior attachments

Class 2

- 7.5% sample of welds on each system
- 100% component supports

Class 3

- 100% component supports including attachments

The Inservice Inspection (ISI) code of record for examination performance, including NDE method selection, examination volume/surface area, and evaluation, for Unit 1 recovery, beginning with revision 2 of this procedure, is the 1995 Edition with Addenda through 1996 of ASME Section XI. Examination component (part) selection will remain the 1974 Edition with Addenda through Summer 1975 of ASME Section XI. Examination component (part) selection includes sections IWB/C-1220, IWB-2500 areas subject to examination, and IWC-2520 areas subject to examination.

The following components will receive inservice examination as currently scheduled in 1-SI-4.6.G (this will complete the percentage requirements for the first inspection interval):

Class 1 (for those components not replaced)

- Piping
- Integral attachments
- Pump and valve interiors
- Vessel nozzle welds
- Pump and valve casing welds

Class 2

- Piping
- Integral attachments
- Vessel welds

Class 3

- Not applicable (100% performed in Re-Baseline)

Question 152

LRA Section B.2.1.7

NRC Issue

Provide the BFN operating experience associated with degradations or indications resulted from past inspections of all welds within the scope of this AMP.

TVA Response

Inspection and flaw evaluation is in accordance with the guidelines of BWRVIP-48. Since the implementation of the guidelines of BWRVIP-48 on Units 2 and 3 (for approximately 4 years) no reportable indications were found. The BWRVIP-48 guidelines will be implemented on Unit 1 prior to restart.

Question 155

LRA Section B.2.1.8

NRC Issue

Changes to plant-operating procedures, such as improved feedwater control, to decrease the magnitude and frequency of temperature fluctuations have been implemented at BFN plants. Is this procedure applicable to all 3 BFN units? If yes, please discuss them for each of the 3 BFN units.

TVA Response

Plant operating instructions to decrease the magnitude and frequency of temperature fluctuations have been implemented for Units 2 & 3. The operating instructions for Unit 1 have not been implemented. The Unit 1 Operating procedures will be upgraded to decrease the magnitude and frequency of feedwater temperature fluctuations prior to Unit 1 restart.

Question 157

LRA Section B.2.1.8

NRC Issue

Leakage monitoring at the thermal sleeve bypass due to degraded thermal sleeve seals or cracks in thermal sleeve welds provide direct assessment of conditions known to lead to nozzle fatigue cracking. Clarify if this system has been implemented in any of the BFN units.

TVA Response

The NUTECH Feedwater Nozzle Bypass Leakage Monitoring System has been implemented for all three units at BFN. BFN Technical Instruction 0-TI-75 ("FEEDWATER NOZZLE THERMAL SLEEVE LEAK DETECTION AND MONITORING PROGRAM") uses the feedwater nozzle thermal sleeve leakage data (through the use of thermocouples which measure feedwater temperature) to monitor the condition of the thermal sleeve seals and in the determination of cumulative feedwater nozzle fatigue usage factor. To date, monitoring shows that the cumulative feedwater nozzle fatigue usage factors are well below the ASME Section III acceptance criteria of 1.0 and the TVA administrative limit of 0.7.

Question 159

LRA Section B.2.1.1

NRC Issue

NUREG-1801 XI.E1, "Electrical Cables and Connections not Subject to 10 CFR 50.49 Environmental Qualification Requirements" states that the technical basis for the sample of cables and connections selected is to be provided. What is the rational for selecting the sample of electrical cables and connections to be inspected, and what is the technical basis for concluding that the sample will be representative of inaccessible cables and connectors for which this program is credited to manage aging?

TVA Response

A representative sample of accessible insulated cables and connections within the scope of license renewal will be visually inspected in adverse localized environments as identified by review of operating experience. Selected cables and connections from accessible areas (the inspection sample) will represent, with reasonable assurance, all cable and connections in adverse localized environments.

Question 160

LRA Section B.2.1.1

NRC Issue

The BFN Element 3 Summary Statement in the Aging Management Program Evaluation GALL XI.E1 10 Element Comparison states that accessible insulated cables and connections within the scope of license renewal will be visually inspected for cable and connection jacket surface anomalies such as embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength. How will visual inspection be used to detect loss of dielectric strength?

TVA Response

This is a grammatical error. The correct wording should be "…and swelling which may result in a loss of dielectric strength".

Question 161

LRA Section B.2.1.9

NRC Issue

Clarify if all 3 BFN units are subject to ASME Section XI, 1995 edition through 1996 addenda. The ISI program includes both PT and UT of critical regions of the CRDRL nozzle. Provide details of the critical zones of the nozzle bend radius region and the type of inspection (UT or PT) committed for each zone applicable to each BFN unit.

TVA Response

See response to Item 147 for applicable Section XI code editions.

The CRDRL nozzles at BFN Units 1, 2 and 3 are capped. The vessel to nozzle weld and inner radius are inspected in accordance with ASME Section XI ISI Program, Subsection IWB, Category B-D requirements. BFN Units 2 and 3 currently perform an enhanced VT-1 visual examination of the inner radius in lieu of the Code required volumetric exam as approved by

Requests for Relief 2-ISI-16 and 3-ISI-14. The current BFN Unit 1 inspection requirement is an UT examination for the nozzle to vessel weld and the inner radius.

Question 163

LRA Section A.1.9

NRC Issue

Describe the maintenance programs (as stated in FSAR supplement) associated with all the system modification components to mitigate cracking in the CRDRL nozzle.

TVA Response

The first sentence of Item (b) of Section A.1.9 of the LRA states "System modifications and maintenance programs to mitigate cracking." This should be revised to read "System modifications mitigate cracking."

Modifications were made to the control rod drive return line per NUREG-0619 and a maintenance program is not required to mitigate control rod drive return line nozzle cracking.

Question 167

LRA Section B.2.1.2

NRC Issue

Justify why Nuclear Instrumentation cables used in circuits like Source Range, Intermediate Range, Average Power Range, Rod Block Monitor, Traversing incore Probe, etc. are not included in the scope of B.2.1.2. Discuss how the aging of the instrumentation cables associated with above mentioned systems will be managed.

TVA Response

The Safe Shutdown Analysis does not list any safety-related intended functions for Source Range and Intermediate Range Nuclear Instrumentation. Therefore, neither Source Range nor Intermediate Range Nuclear Instrumentation circuitry are included in the scope of B.2.1.2.

The Safe Shutdown Analysis does not list any safety-related functions associated with the RBMs. Therefore, the RBMs circuitry is not included in the scope of B.2.1.2.

The only safety-related functions listed in the Safe Shutdown Analysis for the Traversing Incore Probe system (TIP) is provide a reactor coolant pressure boundary. Therefore, TIP circuitry is not in scope of B.2.1.2.

The APRMs and OPRMs do provide safety-related signals. The input to the APRM and

OPRM is provided by the LPRM detectors.

The only cables required for the APRM and OPRM functions that are exposed to potentially adverse localized environments caused by heat or radiation that could result in reduced insulation resistance (IR) are those associated with the LPRM detectors.

The LPRM detector cables are within the scope of B.2.1.2.

Question 169

LRA Section B.2.1.2

NRC Issue

LRA (Page B-18) indicated that aging effects for in-scope radiation monitoring system cables are managed by the BFN Environmental Qualification Program. However, EQ Program (B.3.1) covers certain electrical components that are important to safety and could be exposed to harsh environment accident conditions. Portion of the radiation monitoring cables are not exposed to harsh environment. Please confirm that all in-scope radiation monitoring cables located both inside and outside the containment are covered by the EQ program.

TVA Response

All BFN High Range Radiation Monitor Cables are included in the EQ Program, regardless of their location in mild or harsh areas of the plant.

Question 170

LRA Section B.2.1.2

NRC Issue

On page B-18, you have stated that the procedure (B.2.1.2) is not a normal loop calibration. 1. Please describe the procedure. 2. Does this calibration procedure include cables? 3. Explain in details how the cable aging will be managed.

TVA Response

1. BFN performs a specific calibration procedure as determined from plant Technical Specifications on LPRM circuits. The procedure is not a normal loop calibration. The procedure utilizes actual detector signals during operation to a) adjust the gain of each LPRM circuit to compensate for detector burnout and b) to adjust the gain of each LPRM circuit for normal operating changes in local core power distribution so that output from each LPRM circuit relatively reflects the neutron flux at the detector location and that the sum of LPRM outputs reflects the total core power.

2. The cables are part of the calibration procedure since the detector is in service when the calibration is performed.

3. In this program, review of routine calibration results by appropriate personnel provide sufficient indication of the need for corrective actions by monitoring key parameters related to LPRM cable system performance. The normal calibration frequency specified in BFN Technical Specifications provides reasonable assurance that severe aging degradation will be detected prior to loss of the cable intended function.

Question 173

LRA Section B.2.1.36

NRC Issue

The program is being enhanced to include a number of structural components and structural supports (described on Pages 2 and 3). How are these structural components and supports currently being managed? If they are not currently being managed will a baseline inspection of these structural components and supports be performed prior to the period of extended operation?

TVA Response

The identified structural component supports that are to be added to the Structures Monitoring Program are currently being managed by the plant work control procedures and the corrective action program. All Structures Monitoring Program enhancements required to document structural components and structural support inspections will receive a baseline inspection prior to the period of extended operation. Structures Monitoring Program baseline inspections are currently required by section 5.1 of LCEI-CI-C9.

Question 174

LRA Section B.2.1.36

NRC Issue

Explain why the SMP covers ASME Class MC Supports in lieu of ASME Subsection IWF.

TVA Response

The supports for the BFN drywell, torus and vent system are currently not periodically inspected in accordance with ASME Section XI. Inspection of supports for ASME Class MC components is not required by 10CFR50.55a(g)(4) which states in part ...components (including supports) which are classified as ASME Code Class 1, Class 2 and Class 3 must meet the requirements, ... set forth in Section XI... It later states, Components which are classified as Class MC pressure retaining components and their integral attachments, and components which are classified as Class CC pressure retaining components and their integral attachments must meet the requirements, ... set forth in Section XI...

BFN uses this as the basis for excluding the supports for Class MC components from the scope of ASME Section XI, Subsection IWF inspections. For license renewal, BFN intends to manage aging of the supports for the drywell, torus, and vent system by either the Structures Monitoring Program (for supports in a containment atmosphere or inside air environment) or by the Chemistry Control Program and One-Time Inspections (for supports in a submerged torus water environment). These program descriptions are as defined in LRA Appendices B.2.1.36, B.2.1.5 and B.2.1.29 and provide the necessary mitigative functions, inspection parameters, aging detection methods, monitoring and trending reporting, inspection acceptance criteria, corrective actions, confirmation process, and administrative controls to manage aging for the period of extended operation.

Question 176

LRA Section B.2.1.36

NRC Issue

The enhancements described in the AMP Evaluation Report are not completely described in the FSAR Supplement. Please clarify where the commitment to make these enhancements will be completely documented.

TVA Response

TVA will provide a consolidated list of commitments for the BFN License Renewal Application consistent with NEI letter to NRC dated February 26, 2003 to Dr. P.T. Kuo in regards to the subject: “Industry Response – Consolidated List of Commitments for License Renewal, December 16, 2002.” The FSAR supplement provides a level of detail ensuring aging management program commitments will be implemented. The consolidated list of commitments will be transmitted to the NRC outside of the LRA.

Question 177

LRA Section B.2.1.21

NRC Issue

LRA B.2.1.21 "Compressed Air Monitoring Program" states that the compressed air monitoring system will be consistent with GALL following the implementation of certain enhancements. Enhancement No. 1 specifies an update of the Compressed Air Monitoring Program requirements based on ASME OM-S/G-2000, Part 17, ANSI/ISA-S7.0.01-1996 and EPRI TR-108147. A commitment to perform this revision and upgrade is not included in the FSAR supplement (BFN LRA Appendix A) A.1.19 "Compressor Air System". Please provide rationale for not including this commitment in the FSAR supplement.

TVA Response

TVA will provide a consolidated list of commitments for the BFN License Renewal Application consistent with NEI letter to NRC dated February 26, 2003 to Dr. P.T. Kuo in regards to the subject: "Industry Response – Consolidated List of Commitments for License Renewal, December 16, 2002." The FSAR supplement provides a level of detail ensuring aging management program commitments will be implemented. The consolidated list of commitments will be transmitted to the NRC outside of the LRA.

Question 178

LRA Section B.2.1.10

NRC Issue

GALL states that the resistant materials used for new and replacement components include low-carbon grades of austenitic SS and weld metal, with a maximum carbon of 0.035 wt.% and a minimum ferrite of 7.5% in weld metal and cast austenitic stainless steel (CASS). Inconel 82 is the only commonly used nickel-base weld metal considered to be resistant to SCC; other nickel-alloys, such as Alloy 600 are evaluated on an individual basis. Is this applicable to BFN component at all 3 BFN units?

TVA Response

Yes. TVA, in order to comply with the requirements of Generic Letter 88-01 and NUREG 0313 R2, agreed to mitigate IGSCC in susceptible piping by inspection, repair, and/or replacement. To comply with the requirements of Generic Letter 88-01 and NUREG 0313 R2, the materials in the sections of pipe exposed to fluid temperatures greater than 200°F are being replaced with 316 SS NG material which is not susceptible to IGSCC. The criteria for the design, installation, and testing associated with the replacement or removal of selected piping to limit the susceptibility to IGSCC for all three units at BFN in provided in General Design Criteria BFN-50-779, "Replacement of Selected Piping to Limit Susceptibility to IGSCC", and has been implemented for Units 2 and 3 at BFN by various design changes. Unit 1 is in the process of implementing similar design changes prior to Unit Restart.

Question 181

LRA Section B.2.1.10

NRC Issue

An applicant may use BWRVIP-61 guidelines for BWR vessel and internals induction heating stress improvement effectiveness on crack growth in operating plants. Is this applicable to 3 BFN units?

TVA Response

Induction Heating Stress Improvement (IHSI) and Mechanical Stress Improvement (MSIP) have been used on various welds on both Units 2 and 3 as a remedy to IGSCC in austenitic stainless steel piping. However, the IHSI technique was performed many years prior to the issuance of BWRVIP-61. Unit 1, as part of BFN's response to IE Bulletin 88-01, will perform MSIP on applicable welds in accordance with BWRVIP-61 prior to Unit Restart.

Question 184

LRA Section A.1.36

NRC Issue

LRA A.1.36 - Fatigue Monitoring Program (FSAR Supplement) states "The Fatigue Monitoring Program is used for management of metal fatigue of select components in the reactor coolant pressure boundary and primary containment. It provides for monitoring fatigue stress cycles to ensure that the design fatigue usage factor limit is not exceeded. This program will be enhanced to use EPRI Licensed FatiguePro© Cycle Counting and Fatigue Usage Tracking Computer Program prior to the period of extended operation."

FSAR Supplement does NOT identify the enhancements to expand the program coverage, as listed in LRA B.3.2:

"The enhancements will include expansion of the program coverage as follows:

- This program will include select Reactor Vessel locations as specified in (LRA) Table 4.3.1.1.
- This program will include the locations identified by NUREG/CR-6260 for environmental fatigue evaluation as discussed in (LRA) Section 4.3.4 and in accordance with NUREG 1801 Section X.M1.
- This program will include monitoring the fatigue of the suppression chamber and suppression chamber vents, including the vent headers and downcomers, as specified in (LRA) Section 4.6.1.

TVA will implement all enhancements prior to the period of extended operation."

The applicant is requested to document its commitment to enhance the program coveragein the FSAR Supplement.

TVA Response

TVA will provide a consolidated list of commitments for the BFN License Renewal Application consistent with NEI letter to NRC dated February 26, 2003 to Dr. P.T. Kuo in regards to the subject: "Industry Response – Consolidated List of Commitments for License Renewal, December 16, 2002." The FSAR supplement provides a level of detail ensuring aging management program commitments will be implemented. The consolidated list of commitments will be transmitted to the NRC outside of the LRA.

Question 185

LRA Section B.3.2

NRC Issue

Has AMP B.3.2 Fatigue Monitoring been implemented for Unit 1? If so, when was it implemented? If not, when will it be implemented – at restart?

TVA Response

The Fatigue Monitoring Program as described in LRA Section B.3.2 has not been implemented for Unit 1. As stated in Section B.3.2 "TVA will implement all enhancements prior to the period of extended operation."

Currently Technical Instruction 0-TI-19, "Reactor Vessel Fatigue Usage Factor Evaluation Monitoring, Recording, Evaluating, and Reporting" establishes the program for monitoring, recording, evaluating, and reporting of fatigue usage factors associated with various portions of the reactor vessel. This technical instruction keeps an account on a monthly basis of the cumulative fatigue usage factor at three locations in the pressure vessel; shell at water line, feedwater nozzle and closure studs. This technical instruction is applicable to Units 1, 2, and 3 and the program described in this procedure will be implemented for Unit 1.

Question 186

LRA Section B.3.2

NRC Issue

For locations to be added to the scope of the Fatigue Monitoring Program, as identified under program enhancements, how will the current fatigue usage factor be calculated? This is needed as initial input to either a manual or an automated tracking system.

TVA Response

As discussed in Section B.3.2 of the LRA, BFN will implement the FatiguePro fatigue monitoring system for tracking cycles and the cumulative usage factors (CUF) in critical plant component locations prior to the period of extended operation. FatiguePro monitors CUF for the selected locations in one of two ways:

1. Stress-Based Fatigue Monitoring: Stress-based fatigue (SBF) monitoring consists of computing a “real time” stress history for a given component from actual temperature, pressure, and flow histories via a finite element evaluation based on the Green's Function

approach. CUF is then computed from the computed stress history using appropriate cycle counting techniques, and appropriate ASME Code, Section III fatigue analysis methodology. SBF monitoring is intended to duplicate the methodology used in the governing ASME Code, Section III stress report for the component in question, but uses actual transient severity in place of design basis transient severity.

2. Cycle-Based Fatigue Monitoring: Cycle-based fatigue (CBF) monitoring consists of a two-step process: (a) Automated Cycle Counting, and (b) CUF computation based on the counted cycles:

   a. Automated Cycle Counting:

      Categorization and counting of plant transients is accomplished by the FatiguePro automated cycle counting (ACC) module. The ACC module counts each transient that is defined in the plant licensing basis based on the mechanistic process or sequence of events experienced by the plant (as determined from monitored plant instruments). This approach is conservative because it assumes each actual transient has a severity equal to that assumed in the design basis. The unique severity of any transient identified by FatiguePro is captured for each monitored component, for ready comparison to design basis transient severity. All transients defined in the design basis and the plant Technical Specifications are identified and considered for implementation in the ACC module. Any additional system-specific transients that are experienced by the Group I piping systems, which contribute significantly to the calculated CUF, are also monitored.

   b. CUF Computation:

      CUF computation calculates fatigue directly from counted transients and parameters, as determined by the ACC module, for the monitored components. CUF is computed via a design-basis fatigue calculation where the fatigue table from the governing stress report is used as a basis, but actual numbers of cycles are substituted for assumed design basis numbers of cycles. The CUF calculations are conservative in that design basis transient severity is assumed.

      The monitored locations are discussed in Tables 4.3.1, 4.3.4 and 4.6.1 of the LRA. The components identified in NUREG/CR-6260 for the older vintage BWR plant are encompassed by the locations selected for monitoring.

      For the time period prior to FatiguePro implementation, the initial CUF estimate for both SBF and CBF components are determined based on the cycle counts to-date since initial plant startup and the design basis fatigue calculation methodology described in Item 1, above. These initial CUF estimates, therefore, considered all cycles experienced by the BFN units to-date and assumed design basis severity for each event.

Question 187

LRA Section A.1.17

NRC Issue

FSAR Supplement A.1.17 (CCWS) states "Testing and Inspection in Accordance with EPRI TR-107396 for CCWS is performed to evaluate System Component Performance".

Provide TR-107396 criteria used to perform this evaluation.

TVA Response

In NUREG-1801 the XI.M21 Program Description states: "Surveillance testing and inspection in accordance with standards in EPRI TR-107396 for closed-cycle cooling water (CCCW) systems is performed to evaluate system and component performance." The criteria used to make the determination that testing and inspection in accordance with standards in EPRI TR-107396 are contained in the Evaluation and Technical Basis for the XI.M21 Program in NUREG-1801.

In addition, it has been determined that the program description provided in Appendix B, Section B.2.1.18 is not consistent with the FSAR Supplement A.1.17 description. In particular, the Section B.2.1.18, Closed-Cycle Cooling Water System Program description states:

"The Closed-Cycle Cooling Water System Program includes:

a. Preventive measures to minimize corrosion - The program maintains system corrosion inhibitor concentrations within specified limits to minimize corrosion. An inspection in accordance with the One-Time Inspection Program (B.2.1.29) will verify the effectiveness of the preventive measures.

b. Surveillance testing and inspection to monitor the effects of corrosion on the intended function of the component - Surveillance testing and inspections in accordance with standards in EPRI TR-107396 for closed-cycle cooling water systems are performed to evaluate system and component performance."

The second sentence of paragraph (a) is in error and should be deleted. Paragraph (b) provides the verification of the preventive measures effectiveness.

Question 188

LRA Section B.2.1.34

NRC Issue

The Aging Management Program Evaluation for the Appendix J Program states: BFN revised the Technical Specifications to allow implementation of 'Option B' for Type A, B and C testing. Leakage testing for containment isolation valves is performed under Type C tests. Type C tests are included in the Browns Ferry 10 CFR 50 Appendix J program but are not credited for aging management.

The applicant explained that Type C tests are not credited for aging management because the AMR for containment isolation valves listed in the mechanical sections of the LRA credit different AMPs which are consistent with GALL. The NRC project team noted that the AMPs that are credited for the containment isolation valves appear to be appropriate for valve body integrity, but not leak rate testing. The applicant is requested to explain how the AMPs credited in the LRA for containment isolation valves are equivalent to the requirements for Type C tests included in the Appendix J Program.

TVA Response

NUREG-1801 does not require Appendix J Type C testing for containment isolation valves and associated piping. AMPs credited in the NUREG-1801 provide one acceptable way for aging management of the pressure boundary integrity of the containment isolation valve and penetration. In many cases the AMP would provide preventative measures (Chemistry Control) or other inspections that would detect or minimize aging effects before they could result in unacceptable leakage.

Question 194

LRA Section B.2.1.11

NRC Issue

Provide the operating experience associated with austenitic SS, Ni alloys, and low alloy steel component IGSCC in any of reactor pressure boundary components at 3 BFN plants.

TVA Response

The BWR Penetrations Program monitors the effects of SCC/IGSCC on the intended function of the component by detection and sizing of cracks. The BWR Penetrations Program implements the inspection and evaluation guidelines of BWRVIP-27 and BWRVIP-49. The BWRVIP-49 provides guidelines for instrument penetrations, and BWRVIP-27 addresses the standby liquid control (SLC) system nozzle or housing. Inspections are performed with BFN procedures that implement the requirements of ASME Section XI, Table IWB 2500-1.

BFN Units 2 and 3 have experienced no unacceptable conditions since the implementation (for approximately 4 years) of the BWRVIP-27 and -49 guidelines. These inspections will be implemented on Unit 1 prior to restart.

Question 196

LRA Section B.2.1.11

NRC Issue

The staff SER for BWRVIP-53 and BWRVIP-57 states that these reports are acceptable to the staff for licensee usage, as modified and approved by the staff, at any time during either current operating term or during the extended license period. The staff requested that BWRVIP review and resolve the issues raised in the enclosed SE, and incorporate the staff's conclusions into revised reports. Provide the status of the final dispositions associated with these two reports.

TVA Response

BWRVIP-53 ("Standby Liquid Control Line Repair Design Criteria") and BWRVIP-57 ("Instrument Penetration Repair Design Criteria") are both applicable to BFN. To date, no repairs have been performed on either the standby liquid control line or instrument penetrations for all three units. If repairs were ever required, these criteria would be used per NEDP-23.

Question 199

LRA Section B.2.1.35

NRC Issue

With regard to Element 1, please clarify what procedure identifies all the walls in the masonry wall program that are in the scope of license renewal.

TVA Response

0-TI-346 identifies in-scope structures for maintenance rule and will be enhanced to identify structures within the scope of license renewal that require aging management. LCEI-CI-C9 refers to 0-TI-346 for the detailed listing of structures in the scope of maintenance rule and license renewal. LCEI-CI-C9 requires inspection of masonry walls in structures identified in 0-TI-346.

Question 205

LRA Section B.3.1

NRC Issue

NUREG-1801 X.E1 requires that the analytical models used in the reanalysis of an aging evaluation be the same as those previously applied during the prior evaluation. The BFN 10 element evaluation for the EQ program (page 3, Analytical Methods) states that analytical models used in the reanalysis of an aging evaluation will in most cases be the same as those applied during the initial qualification. In what cases will prior analytical models not be used in a reanalysis and what is the technical basis for not using the same models previously used?

TVA Response

It is the intention of BFN to use the same Analytical Methods as used in the original EQ evaluations. If a different method is used, the basis for using the method will be documented in the EQ Package.

Question 206

LRA Section B.3.1

NRC Issue

NUREG-1801 X.E1 requires that a representative number of temperature measurements be conservatively evaluated to establish the temperatures used in an aging evaluation. How will this requirement be addressed?

TVA Response

BFN currently has no plans to monitor temperatures to extend the qualified life of EQ components. If the need to arises, a representative number of temperature measurements will be used to establish the temperature used in the aging analysis. The collection methodology and the data collected will be documented as part of the EQ Package.

Question 207

LRA Section B.3.1

NRC Issue

Will any changes to material activation energy values be used as part of a reanalysis and, if so, will they be justified specifically for BFN?

TVA Response

BFN currently has no plans to change activation energies as part of the evaluation to extend the life of EQ components. If during the evaluation process, an activation energy is changed, the basis for changing the number will be documented in the EQ Package.

Question 208

LRA Section B.2.1.1

NRC Issue

NUREG-1801 XI.E1 states that the program is written specifically to address cables and connections at plants whose configuration is such that most (if not all) cables and connections installed in adverse localized environments are accessible. What percentage of cables in adverse localized environments is accessible at BFN Units 1, 2, and 3?

TVA Response

Based upon a search of 'as designed' data in the current cable routing database, it was determined that greater than 50% of cables are located in cable trays; therefore, a representative amount of cables are accessible (cables located in cable trays) for inspection activities.

Question 209

LRA Section A.1.24

NRC Issue

M30 (Fuel Oil Chemistry) Element 4 - BFN states that the fuel oil testing and monitoring program will require an enhancement for ultrasonic thickness measurements of tank surfaces to ensure significant degradation is not occurring.

FSAR supplement A.1.24 should be revised to include commitment to enhance the fuel oil testing and monitoring program to include ultrasonic thickness measurements of tank surfaces.

TVA Response

TVA will provide a consolidated list of commitments for the BFN License Renewal Application consistent with NEI letter to NRC dated February 26, 2003 to Dr. P.T. Kuo in regards to the subject: "Industry Response – Consolidated List of Commitments for License Renewal, December 16, 2002." The FSAR supplement provides a level of detail ensuring aging management program commitments will be implemented. The consolidated list of commitments will be transmitted to the NRC outside of the LRA.

Question 211

LRA Section B.2.1.12

NRC Issue

BWRVIP-76 supersedes BWRVIP-07 and BWRVIP-63. BFN will utilize BWRVIP-76 for core shroud inspection and flaw evaluation guidelines during the extended period of operation. BFN states as note 7 on page B-40 of the LRA that when NRC review of this report is complete, BFN will evaluate the NRC SER and complete SER action items. Discuss why this should not be committed in the FSAR supplement.

TVA Response

BFN has committed to the use of BWRVIP documents (Transmittal of Revised BWRVIP Commitment Letter to the NRC, dated June 2, 1997, RIMS R12 970612 789). Committing to use of BWRVIP documents includes evaluating the NRC SER and completing the applicable SER action items.

TVAN STANDARD DEPARTMENT PROCEDURE NEDP-23, BWR REACTOR PRESSURE VESSEL INTERNALS INSPECTIONS (RPVII), provides the guidelines for implementing a boiling water reactor (BWR) vessel internals program. It contains information required to preserve the integrity for BWR reactor pressure vessel (RPV) internals. This program is intended to be a balance of preventive, inspection, and repair as necessary to support regulatory requirements and to implement industry initiatives.

Question 212

LRA Section B.2.1.12

NRC Issue

In accordance with GALL, BWRVIP-44 provides guidelines for weld repair of nickel alloys and BWRVIP-45 provides guidelines for weldability of irradiated structural components. Do BFN's Vessel Internals AMP utilize these BWRVIP guidelines as part of the weld repair activities of RV internal components? If not, then provide justifications for using other guidelines instead of staff-approved BWRVIP guidelines.

TVA Response

Even though BWRVIP-44 and -45 are not specifically mentioned in BWRVIP-94 or NEDP-23 (which implements BWRVIP-94), TVA has previously committed to the use of BWRVIP documents (Transmittal of Revised BWRVIP Commitment Letter to the NRC, dated June 2, 1997, RIMS R12 970612 789). Should weld repair of nickel-based alloys be needed, TVA would follow the guidelines of BWRVIP-44 and -45 as stated in NEDP-23.

Question 260

LRA Section B.3.1

NRC Issue

The BFN LRA Section B.3.1 states that the Environmental Qualification (EQ) program will be implemented on Unit 1 prior to Unit 1 restart from its current extended outage. The UFSAR in the BFN LRA Section A.1.35 states that the EQ program will be implemented for Unit 1 prior to the period of extended operation. Please provide clarification on the implementation schedule for the EQ program at Unit 1.

TVA Response

The EQ program is scheduled to be implemented on Unit 1 prior to restart from its current extended outage to meet current regulatory requirements. However, for license renewal, the UFSAR requires that the EQ program will be implemented on Unit 1 prior to the period of extended operation to ensure SSCs in scope for License Renewal are adequately managed to ensure the intended function(s) will be maintained consistent with the CLB for the period of extended operation.

Question 261

LRA Section Table 3.6.2.1

NRC Issue

In the BFN LRA Table 3.6.2.1, the entry for component type Various Electrical Equipment subject to 10 CFR 50.49 EQ requirements lists "None" for the aging management program; however, the referenced Table 3.6.1.1 item for this component type identifies the EQ program as the aging management program. Please clarify why the EQ program was not identified in Table 3.6.2.1 as the aging management program for this component type.

TVA Response

Table 2 reflects the information in NUREG 1801 Volume 2, and Table 1 reflects the information in NUREG 1801 Volume 1. (Note: Table 1 and Table 2 are defined in section 3.0 of the LRA)

The Standard LRA format examples do not specifically address Table 2 presentation of TLAA information that is also contained in Table 1.

NUREG-1801 Volume 2, Table VI.B item VI.B.1.1 identifies Electrical equipment subject to 10CFR50.49 EQ requirements. The "Aging Management Program" column states that EQ is a time-limited aging analysis to be evaluated for the period of extended operation and refers to Standard Review Plan 4.4. It also discusses 10 CFR 54.21(c)(1) options (i), (ii) and (iii) for acceptable methods of evaluation. For this reason, TVA considers EQ a TLAA instead of an Aging Management Program.

NUREG-1801 Volume 1, Table 6 identifies Electrical equipment subject to 10 CFR 50.49

environmental qualification (EQ) requirements. The "Aging Management Program" column is the "Environmental Qualification of electric components program".

In order to be consistent with NUREG-1801 and refer to Note A, the license renewal application specifies "none" as the aging management program in Table 2 and refers to Table 1 which contains the aging management program requirements for EQ equipment. Table 1 also provides a reference to section 4.4 for TLAA evaluation and a reference to a further evaluation section 3.6.2.2.1.

Question 262

LRA Section Table 3.3.2.28

NRC Issue

The BFN LRA Table 3.3.2.28 identifies cracking of copper alloy components in the diesel generator system heat exchangers as an aging effect requiring aging management (MPCT item Cu-8h), and credits the Open Cycle Cooling Water AMP to manage this aging effect. How will the Open Cycle Cooling Water System program detect cracking prior to the loss of intended function for these components?

TVA Response

The Open-Cycle Cooling Water System Program is implemented by a variety of maintenance, inspection, and testing procedures. The primary method of detecting cracking in heat exchangers is eddy current testing in accordance with the Heat Exchanger Program (NEDP-17). This procedure requires the heat exchanger engineer to coordinate and schedule heat exchanger activities. The actual inspections are scheduled as preventative maintenance tasks. In particular, the Diesel Generator Cooling Water Heat Exchangers are scheduled with a frequency of 2 years.

Question 263

LRA Section n/a

NRC Issue

The BFN LRA indicates no aging effect requiring management for glass fittings, traps and strainers in several systems and environments (MPCT items G-1a, 5a, 6a, 8a, 9a, 11a). What are the specific applications of glass in these systems?

TVA Response

The following components which contain glass are included in the scope of license renewal for BFN:

System 26, High Pressure Fire Protection - level gauge
System 31, Heating, Ventilation, and Air Conditioning - level gauge
System 37, Gland Seal Water - level gauge
System 39, CO2 - level gauge
System 43, Sampling and Water Quality - level gauge
System 64, Containment - level gauge
System 68, Reactor Recirculation - sight glass
System 70, Reactor Building Closed Cooling Water - level gauge
System 82, Diesel Generator - level gauge
System 86, Diesel Generator Starting Air - sight glass
System 90, Radiation Monitoring - sight glass, moisture traps, and air filters

Question 264

LRA Section Table 3.3.2.6

NRC Issue

Table 3.3.2.6 of the BFN LRA identifies fittings constructed of glass in an environment of aqueous fire-fighting foam (AFFF) with no aging effects identified (MPCT item G-11a). What are the chemical properties of "AFFF" and does it have any detrimental effects on glass?

TVA Response

AFFF – Aqueous Film Forming Foam contains:

- Water
- 2-(2-Butoxyethoxy) Ethanol
- Ethylene Glycol
- Alkyl Polyglycoside
- Fluoroalkyl Surfactant

This mixture of hydrocarbons surfactants, fluorosurfactants and water is not reactive with glass.

Question 265

LRA Section Table 3.3.2.21

NRC Issue

Table 3.3.2.21 of the BFN LRA identifies valves constructed of cast austenitic stainless-steel (CASS) in a treated water environment with aging effects of change in material properties due to thermal aging (MPCT item SS-9k) and crack initiation and growth due to SCC (MPCT item SS-9q). The AMP credited for managing these aging effects is the ASME Section XI ISI program. What is the ASME class of these components and are they included in the ASME

Section XI inspection program? Also, what is the basis for concluding that the ASME inspection will detect changes in material properties?

TVA Response

The cast austenitic stainless steel valves that are included in this line item are the Reactor Water Cleanup System 1" root valves providing flow to and from the recently added Durability Monitoring Panels for Units 2 and 3. These valves are Non-Nuclear Code Class and, therefore, the ASME Section XI Subsections IWB, IWC and IWD Inservice Inspection Program in not applicable.

Thermal embrittlement degrades the mechanical properties of material (strength, ductility, toughness) as a result of prolonged exposure to high temperatures. Cast austenitic stainless steel materials are susceptible to thermal embrittlement. The degree of susceptibility is dependent upon material composition and time at temperature. The maximum time these valves would be exposed to these high temperatures would be for BFN Unit 3. The Unit 3 valves were installed in the spring 2000 refueling outage with a proposed license expiration date of July 2, 2036. This represents a potential for approximately 36.5 years of operation at the elevated temperatures. The Unit 2 valves were installed in the spring 2001 refueling outage with a proposed license expiration date of June 28, 2034, or approximately 33.5 years of operation. None of these CASS valves will be operated beyond their original 40 year design life and thermal aging has not been identified as a current license basis (40 years) issue.

NRC letter, "License Renewal Issue No. 98-0030, Thermal Aging Embrittlement of Cast Austenitic Stainless Steel Components," dated May 19, 2000 from Mr. C. I. Grimes (NRC) to D. J. Walters (NEI) provides the staff evaluation of this issue. The staff guidance in this letter states:

> Valve bodies and pump casings are adequately covered by existing inspection requirements in Section XI of the ASME Code, including the alternative requirements of ASME Code Case N-481 for pump casings. Screening for susceptibility to thermal aging is not required and the current ASME Code inspection requirements are sufficient.
>
> Regarding valve bodies with NPS less than 4 in., this position is supported by a bounding fracture analysis finding that valves within this range do not require additional inspection or evaluation to demonstrate that the material has adequate toughness, even for severe thermal embrittlement conditions.

For a 1 inch valve, the Section XI inspection would be an external visual examination.

The conclusion of the bounding fracture analysis from Attachment 2 of this letter states:

> Even after severe thermal embrittlement, a CASS valve loaded to the maximum anticipated stress can sustain a through wall crack well in excess of its wall thickness without fracturing. The worst case conditions assumed here suggest that requirements for

licensees to either (a) inspect, or (b) provide analysis to demonstrate the fracture integrity of these components would represent an unnecessary duplication of effort.

The conclusion of this fracture analysis was that an inspection is an unnecessary duplication of effort. Note, recognizing the existing Section XI inspection requirement for Class 1 valves does not add additional inspection requirements. For these Class 3 valves, the inspection would be an additional inspection which the NRC's evaluation determined was an "unnecessary duplication of effort."

Therefore based on the following conclusions thermal aging of these 1 inch NPS CASS valves is not an aging effect that requires management.

- Thermal aging is not a current license basis issue and is a concern for operation beyond forty years. These valves will be operated for less than forty years, including the period of extended operation.
- Even assuming thermal aging for valves is a current licensing basis concern, the conclusion from the NRC's bounding fracture analysis for valves less than 4 inches NPS was that "a CASS valve loaded to the maximum anticipated stress can sustain a through wall crack well in excess of its wall thickness without fracturing" and "that requirements for licensees to either (a) inspect . . . of these components would represent an unnecessary duplication of effort."

However, to resolve this issue, thermal aging will be identified in the LRA as being an aging effect requiring management for these 1 inch NPS non-Class 1 valves. The Systems Monitoring Program will be identified as the aging management program to perform an external visual inspection.

Question 266

LRA Section Table 3.3.2.9

NRC Issue

Table 3.3.2.9 of the BFN LRA identifies various components constructed of stainless steel in a treated water environment with an aging effect of crack initiation/growth (MPCT item SS-9m). The AMP credited for managing this aging effect is the Closed Cycle Cooling Water program (B.2.1.18). How will the Closed-cycle Cooling Water program detect cracking prior to the loss of intended function for these components?

TVA Response

Table 3.3.2.9, Heating, Ventilation, and Air Conditioning, identifies stainless steel components in a treated water environment as being susceptible to cracking due to stress corrosion cracking. These components were identified with precedence note SS-9m. The components this aging effect applies to are in a hot water building heating subsystem. Heating is not required as a license renewal function and these components are only in scope for a(2) concerns. The Closed-Cycle Cooling Water System Program is not the appropriate aging management program for these components. Instead the aging effects in this subsystem are managed by the Chemistry Control Program and the One-Time Inspection Program.

In addition, the components identified with precedence note SS-8e have cracking of stainless steel in a raw water environment identified in System 29, Potable Water, and System 31, Heating, Ventilation, and Air Conditioning. It has been determined that this cracking aging effect is unnecessary. This is addressed in Question 313.

FOLLOWUP NRC QUESTION:

Is the Closed-Cycle Cooling Water program used in other systems to detect cracking? If so, how will this program detect cracking prior to the loss of intended function for these components?

FOLLOWUP TVA RESPONSE:

Two other applications of the Closed-Cycle Cooling Water System Program two manage cracking were identified in the BFN LRA.

Table, 3.3.2.6, High Pressure Fire Protection System has one line item for stress corrosion cracking of an aluminum heater in the diesel-driven fire pump jacket cooling water subsystem. The diesel-driven fire pump is inspected for signs of leakage following periodic tests, including the diesel. The Closed-Cycle Cooling Water System Program is not the appropriate aging management program for these heaters. Instead the aging effects in the diesel-driven fire pump jacket cooling water subsystem are managed by the Chemistry Control Program and the One-Time Inspection Program.

Table 3.3.2.28, Diesel Generator System has one line item for stress corrosion cracking of stainless steel fittings in the diesel jacket cooling water subsystem. This aging effect is inappropriate as temperature is less than 140°F. This aging effect should be deleted from Table 3.3.2.28.

Question 267

LRA Section Table 3.3.2.11

NRC Issue

Table 3.3.2.11 for the Service Air System in the BFN LRA (12 line items) is not consistent with the version of Table 3.3.2.11 amended to include the Precedence Basis Notes (35 line items). Please clarify which version of Table 3.3.2.11 is correct.

TVA Response

Corrected version of Table 3.3.2.11 was provided to the audit team.

Question 275

LRA Section Table 3.1.2.3

NRC Issue

The LRA Table 3.1.2.3 (row 51) item on Valves-RCPB is not consistent with the GALL item IV.C1.3-c. The LRA item includes chemistry control, BWR stress corrosion cracking and one time inspection AMPs to manage cracking due to SCC in Valves-RCPB, made of stainless steel in treated water. However, GALL item IV.C1.3-c does not include one time inspection AMP as one of the suggested AMPs. Discuss why LRA includes one time inspection AMP to manage cracking in stainless steel valves.

TVA Response

The aging management programs that were identified in LRA Table 3.1.2.3 (row 51) were reviewed and it was determined that the One-Time Inspection had been inadvertently included. The One-Time Inspection Program will be deleted from this row.

Question 276

LRA Section Table 3.1.2.2

NRC Issue

The LRA Table 3.1.2.2 (row 20) item on Reactor Vessel Internals Dry Tubes and Guide Tubes is not consistent with the GALL item IV.B1.4-d. The LRA item includes chemistry control and BWR vessel internals AMPs to manage cracking due to SCC. Explain this discrepancy and identify the GALL item that is consistent with the LRA item.

TVA Response

In LRA Table 3.1.2.2 (row 20), the NUREG-1801, Volume 2 Item number was incorrectly listed as IV.B1.4d. The correct NUREG-1801, Volume 2 Item number is IV.B1.6a, which is consistent with the listed aging effects and aging management programs.

Question 277

LRA Section Table 3.1.2.4

NRC Issue

To be consistent with GALL item IV.C1.1-i, the Fitting-RCPB, LRA Table 3.1.2.4 (row 48), requires chemistry control AMP to manage cracking in treated water. Provide reasons why the chemistry control AMP is not included for this LRA item.

TVA Response

The Chemistry Control Program was inadvertently excluded for this line item in Table 3.1.2.4, Reactor Recirculation. Table 3.1.2.4, (row 48) will be revised to include the Chemistry Control Program as an aging management program. The remaining eight line items for crack initiation/growth due to stress corrosion cracking included the Chemistry Control Program as required.

Question 278

LRA Section LRA Table 3.2.2.5

NRC Issue

The LRA Table 3.2.2.5 (row 87) item on Valves-RCPB is not consistent with the GALL item IV.C1.3-c. The LRA item includes chemistry control and one time inspection AMPs to manage cracking due to SCC in stainless steel in treated water. However, the GALL item IV.C1.3-c does not include one time inspection AMP as one of the suggested AMPs. Instead, it includes BWR stress corrosion cracking AMP. Discuss how one time inspection AMP will manage cracking due to SCC in stainless steel valves for the period of extended operation.

TVA Response

The correct aging management programs for LRA Table 3.2.2.5, row 87 are the Chemistry Control Program and the Boiling Water Reactor Stress Corrosion Cracking Program.

Question 279

LRA Section n/a

NRC Issue

The One-Time Inspection AMP is credited in many places throughout LRA Tables 3.1.1, 3.2.1, 3.3.1, and 3.4.1.

Please specifically verify that the "Components" listed in the following LRA Table entries are included in the scope of the One-Time Inspection AMP:

LRA TABLE 3.1.1
Line 3.1.1.7

Line 3.1.1.8

LRA TABLE 3.2.1
Line 3.2.1.2
Line 3.2.1.3
Line 3.2.1.4
Line 3.2.1.5

LRA TABLE 3.3.1
Line 3.3.1.1
Line 3.3.1.4
Line 3.3.1.5
Line 3.3.1.7

LRA TABLE 3.4.1
Line 3.4.1.2

TVA Response

LRA, Appendix B, Section B.2.1.29 provides the following description and scope for the One-Time Inspection Program.

The One-Time Inspection Program will include measures to verify that unacceptable degradation is not occurring; thereby validating the effectiveness of existing AMPs or confirming that there is no need to manage aging-related degradation for the period of extended operation.

The One-Time Inspection Program will include the one-time inspections of systems, structures, and components that are identified in the Aging Management Review, such as:

- Reactor coolant pressure boundary piping, valves, tubing, restricting orifices, and fittings less than four inch NPS exposed to reactor coolant for loss of material and cracking.
- Ventilation ductwork for loss of material and elastomer degradation/deterioration.
- Flexible connections for loss of material, cracking, and elastomer degradation/deterioration.
- Heat exchangers for loss of material, cracking, and biofouling.
- Various fittings, piping, valves, pumps, strainers, tanks, traps, tubing, expansion joints, fan housings, fire dampers, and heaters for loss of material, cracking, and biofouling.

The one-time inspection required for LRA Table 3.1.1, Lines 3.1.1.7 and 3.1.1.8 for cracking of small-bore reactor coolant system and connected systems piping, jet pump sensing line and reactor vessel flange leak detection line are included in the first item above. Note that no GALL Volume 2 line items are consistent with LRA Table 3.1.1, Line 3.1.1.8 as clarified in the associated further evaluation.

The one-time inspection required for LRA Table 3.2.1, Lines 3.2.1.2, 3.2.1.3, 3.2.1.4, and 3.2.1.5; LRA Table 3.3.1, Lines 3.3.1.1, 3.3.1.4, 3.3.1.5, and 3.3.1.7; and LRA Table 3.4.1, Line 3.4.1.2 are to verify effectiveness of the Chemistry Control Program (except as clarified in the associated further evaluation) are included in the last item above.

Based on this review, the components that match the referenced LRA Line Items are included in the scope of the One-Time Inspection Program.

Question 280

LRA Section Tables 3.3.2.1 through 3.3.2.34

NRC Issue

In the AMR for Auxiliary Systems, presented in Tables 3.3.2.1 through 3.3.2.34, there are numerous GALL Vol. 2 Item references to "VII.I". "VII.I" covers "carbon steel components". However, many of the table entries include materials other than "carbon steel".

Please explain the basis for referencing "VII.I" for the following materials:

Cast iron and cast iron alloy, aluminum alloy, copper alloy, stainless steel, elastomers, glass, polymers, nickel alloy, zinc alloy.

TVA Response

As a member of the 2003 class of license renewal application, Browns Ferry was provided a list of generic notes to identify differences from the GALL, with the intent being to identify the nearest available match to GALL.

GALL includes external environments primarily in three GALL Sections, V.E, VII.I, and VIII.H. GALL Sections V.E, VII.I, and VIII.H only address the aging of carbon steel components, however, since these sections are where external environments are grouped, in most cases the BFN LRA identifies one of these sections as the closes match for comparing external environments. The BFN LRA identifies a GALL match when the actual material and environment matches that described in GALL Sections V.E, VII.I, and III.H. If the material and/or external environment do not match GALL, then the differences in material and/or external environment are noted.

Question 281

LRA Section Tables 3.3.2.1 through 3.3.2.34

NRC Issue

In reviewing the AMR for Auxiliary Systems, presented in Tables 3.3.2.1 through 3.3.2.34, the project team identified several table entries that appear to be mis-classified as "past precedence", where there appears to be a match with GALL.

Please explain the process used to determine whether a specific table entry matches GALL or is dispositioned based on "past precedence."

TVA Response

The BFN LRA Aging Management Evaluation results were compared to GALL for consistency by first determining which GALL Section most nearly matched the system/component. The selected GALL Section is identified in the Aging Management Evaluation tables by the GALL Volume 2 line number, if any. For example, the fuel oil forthe diesel driven fire pump was determined to correspond with GALL Item VII.G.8 a, Diesel Fire System. Following identification of the corresponding GALL Item, if any, then a comparison of material, environment, aging effect/mechanism, and aging management program was performed. If all four of the characteristics sufficiently match, the line item was determined to be consistent with GALL and the Volume 1, Table 1 item number is added to the table. Otherwise, a generic note is identified to note why the item was determined to not match GALL and a past precedence is identified from previous applications, if available.

For example, the fuel oil for the diesel driven fire pump was determined to correspond with GALL Item VII.G.8 a, Diesel Fire System. This results in some BFN LRA Aging Management Evaluation results being identified as inconsistent with GALL when compared to GALL Item VII.G.8 a, whereas the same line items would have been consistent with GALL had the diesel driven fire pump fuel oil been compared to GALL Item VII.H1, Diesel Fuel Oil System, or GALL Item VII.H2.5-a, Diesel Engine Fuel Oil Subsystem. These lines are however, consistent with past applications.

Question 282

LRA Section Table 3.5.2.26

NRC Issue

Precedent AL-2a (LRA Table 3.5.2.26, Row No. 14) – Provide the technical basis for concluding that no aging management of aluminum supports is required for loss of mechanical function in an inside air environment.

TVA Response

LRA Table 3.5.2.26 row #14 applies to aluminum pipe lugs for equivalent ASME Class 2 or 3 piping in the Reactor Buildings (inside air environment). Precedent AL-4a (aluminum in an inside air environment) should be referenced instead of precedent AL-2a (aluminum in a containment atmosphere) in the question. Aluminum external surfaces are not susceptible to corrosion unless their surfaces are wetted and there is a potential for concentration of contaminants. The aluminum pipe lugs in the Reactor Building are not exposed to a wetted aggressive/corrosive environment. Therefore the potential for concentration of contaminates is not significant for aluminum components in an inside air environment and loss of mechanical function due to corrosion is not considered plausible. In the EPRI structural tools document, "Aging Effects for Structures and Structural Components (Structural Tools) EPRI 1002950 Revision 1, August 2003 it states that aging management is not required for structural aluminum and aluminum alloys in an inside environment (general, galvanic, crevice, pitting corrosion and stress corrosion cracking (SCC)). A review of Browns Ferry operating history did not reveal any loss of intended function due to aging effects for aluminum pipe lugs for equivalent ASME Class 2 or 3 piping in the Reactor Buildings for an inside air environment.

Question 283

LRA Section Table 3.5.2.12

NRC Issue

Precedent AL-5a (LRA Table 3.5.2.12, Row 13; 3.5.2.26, Rows 25 and 59) – Provide the technical basis for concluding that no aging management of aluminum components is required for an outside environment.

TVA Response

The following aluminum components in an outside air environment are identified.

1. Electrical and I&C penetrations
2. Conduits and supports
3. Non-ASME equivalent supports

Aluminum alloys containing zinc are susceptible to corrosion in wetted aggressive environments. The outside air environment does not have contaminants that would cause an aggressive environment. Additionally, rain would periodically wash any contaminant(s) from the material. The aluminum penetration sleeves and conduit at BFN are also constructed of 6063-T42 alloy material that is resistant to pitting, crevice corrosion and SCC [Ref. Metals Handbook, Ninth Edition, Volume 13, "Corrosion," ASM International, 1987]. Therefore, the potential for concentration of contaminates is not significant for aluminum components in an outside air environment and loss of function due to corrosion is not considered plausible.

In the EPRI structural tools document, "Aging Effects for Structures and Structural Components (Structural Tools) EPRI 1002950 Revision 1, August 2003 it states that aging management is not required for structural aluminum and aluminum alloys in a non-aggressive ambient outside environment (general, galvanic, crevice and pitting corrosion and SCC).

A review of Browns Ferry operating history did not reveal any loss of intended function due to aging effects for the following aluminum components:

- Electrical and I&C penetrations
- Conduits and supports
- Non-ASME equivalent supports

<u>Question</u> 284

<u>LRA Section</u> Table 3.5.2.2

<u>NRC Issue</u>

Precedent CF-4a (LRA Table 3.5.2.2, Row No. 15; 3.5.2.5, Row No. 10) – Provide the BFN technical basis for concluding that no aging management is required for ceramic fiber fire barriers in an inside air environment.

<u>TVA Response</u>

The following ceramic fiber components in an inside air environment are identified:

- Reactor Building fire barriers
- Diesel Generator Building fire barriers

Ceramic and glass fiber used to seal fire barrier penetrations do not have any applicable aging effects requiring aging management. This is consistent with the Fort Calhoun License Renewal SER concurrence that there are no applicable aging effects for glass used in a metal fire barrier penetration [Fort Calhoun SER, ADAMS accession number ML032481209]. This is also consistent with NUREG-1769 SER related to the License Renewal of Peach Bottom Atomic Power Station 2 and 3 concurrence that insulation made of aluminum, stainless steel (mirror), calcium silicate, ceramic fiber, or fiberglass in a sheltered environment does not have any aging effects requiring aging management.

A review of Browns Ferry operating history did not reveal any loss of intended function due to aging effects for the following ceramic fiber components:

- Reactor Building fire barriers
- Diesel Generator Building fire barriers

<u>Question</u> 285

<u>LRA Section</u> Table 3.5.2.19

NRC Issue

Precedent CS-1b (LRA Table 3.5.2.19, Row No. 9) - The program comparison CS-B states that the Structures Monitoring Program relies on visual inspections whenever the components are uncovered during station yard area excavations. Please confirm that this applies to buried mechanical penetrations. Also clarify what other "components" are included in this provision and explain whether this is an enhancement to the existing program or where this provision is covered in the current program.

TVA Response

The BFN Procedure for Walkdown of Structures for Maintenance Rule (LCEI-CI-C9) will be enhanced to include inspection of mechanical penetrations when accessible. There are no other buried carbon steel components included with the program comparison CS-B, however LCEI-CI-C9 will also be enhanced to include the inspection of buried concrete when accessible. With enhancements, BFN Procedure for Walkdown of Structures for Maintenance Rule (LCEI-CI-C9) will be consistent with NUREG-1801 XI.S6 – Structures Monitoring Program.

The Browns Ferry Buried Piping and Tanks Inspections Aging Management Program provides the inspections requirements of buried piping when accessible. The Browns Ferry Buried Piping and Tanks Inspections Aging Management Program is consistent with NUREG-1801 XI.M34. Section 7.2.9.2 of BFN Procedure for Walkdown of Structures for Maintenance Rule (LCEI-CI-C9) currently provides the inspection attributes of buried piping, which includes pipe connections and joints and is credited as the Browns Ferry Buried Piping and Tanks Inspections Aging Management Program.

Question 286

LRA Section Table 3.5

NRC Issue

CS-3b (All applicable LRA Table 3.5 Items) – It is recognized that all metals embedded/encased in concrete are inaccessible; however, they could be susceptible to aging degradation. Please provide an AMR for further evaluation of embedded/encased components if aging of components in accessible areas is identified that may indicate aging of the inaccessible components.

TVA Response

The BFN concrete structures and concrete components are designed in accordance with ACI 318-63 and 71 and constructed using ingredients conforming to ACI and ASTM standards, which provide for a good quality, dense, well cured, and low permeability concrete. Cracking is controlled through proper arrangement and distribution of reinforcing bars.

Concrete structures and concrete components are constructed of a dense, well-cured concrete with an amount of cement suitable for strength development, and achievement of a water-to-cement ratio that is characteristic of concrete having low permeability. This is consistent with the recommendations and guidance provided by ACI 201.2R-77.

As a minimum, all exposed portions of embedded/encased carbon steel structural components are inspected by the Structures Monitoring Program for the following aging effects:

- Outside Air Environments: Loss of material due to general and pitting corrosion
- Inside Air Environments: Loss of material due to general corrosion
- Containment Air Environments: Loss of material due to general corrosion

The condition of the exposed portion of the embedded/encased carbon steel will provide an indication of the condition of the embedded/encased portion of the carbon steel. If a deficient condition is identified for the exposed portion of the embedded/encased carbon steel material, the TVA corrective action program (SPP-3.1) would document the deficient condition. Resolution of the deficient condition would require the development of a corrective action plan and consideration would be given to the extent of the deficient condition in the development of the corrective actions, which would include the embedded/encased portion of the material as warranted by the deficient condition.

A review of Browns Ferry operating history did not reveal any loss of intended function due to aging effects for carbon steel components embedded/encased in concrete.

Question 287

LRA Section Table 3.5.2.26

NRC Issue

Precedent CS-6a (LRA Table 3.5.2.26, Row No. 57) – Identify the components included in this item, where they are located and the submerged environment. Provide the technical basis for not including these component types in the One-Time Inspection Program to confirm the effectiveness of the Chemistry Control Program.

TVA Response

Table 3.5.2.26 row 57 applies to carbon steel non-ASME equivalent supports inside the condensate water storage tank (CWST). Aging of carbon steel supports submerged in the CWST (treated water environment) will be managed through monitoring CWST water chemistry by the Chemistry Control Program. Effectiveness of the CWST Chemistry Control Program will be confirmed by the One-Time Inspection Program of carbon steel mechanical components in a treated water (condensate water environment) as noted in LRA Table 3.4.2.2 (Condensate and Demineralized Water System).

Question 288

LRA Section Table 3.5.2.17

NRC Issue

Precedent EF-1a (LRA Table 3.5.2.17, Row No. 1) – This item indicates that the equipment supports and foundations are earth fill (rock and sand). Please explain the technical bases for concluding that there are no aging effects requiring management.

TVA Response

The foundation for the condensate water storage tank (CWST) is comprised of a concrete ring foundation with the interior portion of the ring foundation filled with crushed rock and sand. The earthen materials (rock and sand) of the CWST foundation interior base are protected from environmental weathering conditions by the concrete perimeter ring and CWST tank bottom. There are no aging effects for the earthen materials of the CWST foundation interior base that require aging management. Aging management of the Browns Ferry CWST concrete foundation ring is managed by the Structures Monitoring Program. Aging management of the CWST bottom will be performed by the One Time Inspection Program.

A review of Browns Ferry operating history did not reveal any loss of intended function due to aging effects for earthen materials of the CWST foundation interior base.

Question 289

LRA Section Table 3.5.2.2

NRC Issue

Precedent EL-3a (LRA Table 3.5.2.2, Row No. 4) – Please clarify if the compressible joints and seals that are embedded/encased in concrete are accessible for monitoring. If not, how is the Structures Monitoring Program utilized to manage aging effects in inaccessible areas?

TVA Response

LRA Table 3.5.2.2 row 4 and row 5 apply to the seal around the Reactor Building access doors. Row 4 applies to the portion of the seal that is embedded/encased and row 5 applies to the portion of the seal that is exposed to the inside air environment of the Reactor Building. An embedded/encased environment will minimize aging effects due to elastomer degradation caused by inside air environment (ambient conditions of ultraviolet radiation, ozone, temperature, etc.). The Structures Monitoring Program will periodically inspect the portion of the seal that is exposed to the inside air environment of the Reactor Building for aging effects due to elastomer degradation. The condition of the exposed portion of the seal will provide an indication of the condition of the embedded/encased portion of the seal. The inaccessible portions of the embedded/encased seal for the Reactor Building access door will be monitored with the periodic inspections of the seal that are exposed to the air environment of the reactor building.

Question 290

LRA Section LRA Table 3.5.2.1

NRC Issue

Precedent LU-2a (LRA Table 3.5.2.1, Row No. 37) – Describe where used and provide the technical basis for concluding that no aging management of the lubrite plates used in BFN is required in a containment atmosphere.

TVA Response

Table 3.5.2.1 row 37 applies to the lubrite plates used for the drywell floor beam seats. EPRI 1002950, "Aging Effects for Structures and Structural Components (Structural Tools), Revision 1", states that lubrite material resists deformation, has a low coefficient of friction, resists softening at elevated temperatures, absorbs grit and abrasive particles, is not susceptible to corrosion, withstands high intensities of radiation, and will not score or mar. Lubrite products are solid, permanent, completely self lubricating, and require no maintenance. The Browns Ferry containment atmosphere at the location of the drywell floor beam seats is not an aggressive or wetted environment.

A search of Brown Ferry and industry operating experience did not identify any instances of Lubrite plate degradation or failure to perform its intended function due to aging effects. NUREG-1759, "Safety Evaluation Report Related to the License Renewal of Turkey Point Nuclear Plant, Units 3 and 4" and NUREG-1769, "Safety Evaluation Report Related to the License Renewal of Peach Bottom Atomic Power Station, Units 2 and 3", concur that there are no lubrite plate aging effects that require aging management.

Question 291

LRA Section Table 3.5.2.1

NRC Issue

Precedent LU-4a (LRA Table 3.5.2.1, Row No. 37) – Describe where used and provide the technical basis for concluding that no aging management of the lubrite plates used in BFN is required in an inside air environment.

TVA Response

Note: This RAI should reference LRA Table 3.5.2.26 row 35 within the question. Table 3.5.2.26 row 35 applies to the lubrite plates used for the Core Spray and RHR pump/equipment base supports. EPRI 1002950, "Aging Effects for Structures and Structural

Components (Structural Tools), Revision 1" August 2003, states that Lubrite material resists deformation, has a low coefficient of friction, resists softening at elevated temperatures, absorbs grit and abrasive particles, is not susceptible to corrosion, withstands high intensities of radiation, and will not score or mar. Lubrite products are solid, permanent, completely self lubricating, and require no maintenance. The Browns Ferry Reactor Building environment at the location of the Core Spray and RHR pump equipment base supports is not an aggressive or wetted environment.

A search of Brown Ferry and industry operating experience did not identify any instancesof lubrite plate degradation or failure to perform its intended function due to aging effects. NUREG-1759, "Safety Evaluation Report Related to the License Renewal of Turkey Point Nuclear Plant, Units 3 and 4" and NUREG-1769, "Safety Evaluation Report Related to the License Renewal of Peach Bottom Atomic Power Station, Units 2 and 3", concur that there are no lubrite plate aging effects that require aging management.

Question 292

LRA Section Table 3.5.2.26

NRC Issue

Precedent RC-1c (LRA Table 3.5.2.26, Row No. 41) – This item applies to buried reinforced concrete equipment supports and foundations. Explain how the Structures Monitoring Program is used to manage these buried (presumably inaccessible) components. Also see project team Question 297 on LRA Section 3.5.2.2.2.2.

TVA Response

Table 3.5.2.26 row 41 applies to transformer pads/foundations in the Transformer Yard, 161kV Switchyard and 500kV Switchyard in a buried environment. The electrical equipment concrete foundations are exposed to both the outside air environment and the inaccessible buried environment. The outside air environment is addressed in LRA Table 3.5.2.26 row 44. Reduction in concrete anchor capacity will manifest itself at the anchor locations which are located in the outside air environment. The Structures Monitoring Program will manage reduction of concrete anchor capacity for those portions of the equipment foundations exposed to the outside air environment. Aging management for below grade inaccessible concrete will be based on inspection of the accessible concrete in the outside air environment.

Question 293

LRA Section Table 3.5.2.2

NRC Issue

LRA Table 3.5.2.2, Row No. 60 – The AMP referenced for spent fuel pool liners is not consistent with GALL Item III.A5.2-b. The Chemistry Control Program is referenced.

However, GALL also includes "monitoring of the spent fuel pool level." Please provide the technical basis for this omission.

TVA Response

The aging management program section for LRA Table 3.5.2.2. row 60 should have identified that the spent fuel pool level is monitored by plant operations. Browns Ferry will submit a change to correct this omission.

Question 294

LRA Section 3.5.2.2.1.4

NRC Issue

LRA Section 3.5.2.2.1.4 – Provide details of the UT measurements in the sand pocket region for all three units, including comparisons with the original wall thicknesses and trending results. Discuss future planned inspections of steel containment corrosion in the sand pocket region for all three units. Discuss basis for not inspecting other regions of the drywell for all three units in light of the evidence of water leaking from the sand bed drains. It is noted that there is expansion foam in the air gap between the drywell shell and the surrounding concrete that can become wet as a result of the leaking water. Thus other areas of the drywell shell could be susceptible to corrosion. This question also applies to Precedent CS-3a (LRA Table 3.5.2.1, Row No. 28).

TVA Response

In response to NRC Generic Letter 87-05, which addressed the potential for corrosion of boiling water reactor (BWR) Mark I steel drywells in the "sand pocket region", TVA provided the NRC with the results of the ultrasonic testing for corrosion degradation of drywell liner plate, on Aug. 30, 1988. The results of the ultrasonic testing states: Each unit's drywell was ultrasonically tested near the sand cushion area during 1987. The results from these tests showed that the nominal thickness was maintained on each drywell. Below are the results of each units drywell ultrasonic testing: (NOTE - the results stated below are quoted from the TVA to NRC letter dated August 30, 1988)

- Unit 1- No reading below the nominal thickness of one inch was measured indicating that the integrity of the drywell liner plate is maintained. Periodic leakage from the sand cushion area has been observed. Corrosive species in the drainage are bases to suspect a higher rate of corrosion on Unit 1 drywell liner plate than on Unit 2 and 3. However, objective evidence of serious corrosion damage was not noted.

- Unit 2- No reading below the nominal thickness of one inch was measured indicating that no damage to the integrity of the drywell liner plate has occurred.

- Unit 3- No reading below the nominal thickness of one inch was measured indicating that no damage to the integrity of the drywell liner plate has occurred.

Procedure SPP-9.1, “ASME Section XI” is the TVA standard to establish administrative controls and provide requirements, standard methods, guidance, and interfaces for preparation of ASME Section XI and augmented inservice inspection and testing programs at each nuclear site. In addition, this procedure allows for the control and dissemination of the site programs as "stand-alone" documents, as it is required to meet the individual site specific requirements resulting from the physical plant differences. 0-TI-376, “ASME Section XI Containment Inservice Inspection Program Units 1, 2 and 3” (CISI) is an administrative Technical Instruction employed to implement the Inservice Inspection provisions of SPP-9.1 relative to Class MC components at Browns Ferry Units 1, 2, and 3. Appendix 9.7 to 0-TI-376 documents the BFN units 2 and 3 evaluation of Class MC components for determination of augmented examination requirements in accordance with Table IWE-2500-1, Category E-C, Containment Surfaces Requiring Augmented Examination. Included as one of the areas to evaluate for augmented inspections was the “Drywell SCV at the sand bed region”. The evaluation considered the potential degradation mechanisms of each area; the adequacy of existing BFN programs and maintenance practices with respect to the monitoring, prevention, and correction of degradation; and industry experience applicable to the area; then provided a conclusion with respect to augmented examination requirements.

The drywell SCV at the sand bed region evaluation summarized the response to GL 87-05 and the need to obtain more data to conclude whether augmented inspections were warranted. UT thickness measurements of this area were obtained during the U3C8 and U2C10 refueling outages. The data indicate that the condition of the drywell steel liner plate in this area is good, and that this area should not be categorized for augmented examination for Units 2 and 3.

As part of the restart activities for Unit 1, a similar evaluation will be performed to determine if augmented inspections would be required. This evaluation and conclusion will be included in 0-TI-376 prior to Unit 1 restart.

Aging management of drywell corrosion will be addressed by D-RAI 3.5-4.

Question 295

LRA Section 3.5.2.2.1.7

NRC Issue

LRA Section 3.5.2.2.1.7 – Clarify if there has been any operating history at all three units beyond the past five years regarding signs of cracking and/or failures associated with the vent line and penetration bellows. Discuss the hardship or unusual difficulty for TVA regarding reinstatement of Examination Categories E-B and E-F.

TVA Response

During the last 9 years, there is no operating experience at Browns Ferry that indicate cracking or other aging effects resulted in a loss of intended function of the vent line bellows or penetration bellows.

In accordance with 10 CFR 50.55a, the performance of examinations required by Examination Category E-B and Examination Category E-F are optional. The NRC Staff has found no evidence of industry problems with these welds.

Specific weld locations on the containment would be required to be located and identified on weld maps in order to perform examinations for Examination Category E-B and Examination Category E-F. These weld locations have not been identified for the ASME Section XI Subsection IWE ISI program. The hardship associated with performing the weld examinations associated with Examination Category E-B and Examination Category E-F is attributed to radiation exposure received while performing examinations of welds that have no industry experience of problems. Since specific weld locations have not been identified for the ASME Section XI Subsection IWE ISI program, it is not possible to provide an estimated radiation exposure for performance of the examinations.

The Summary of SECY-96-080, "Issuance Of Final Amendment To 10 CFR 50.55a To Incorporate By Reference The ASME Boiler And Pressure Vessel Code (ASME Code), Section XI, Division 1, Subsection IWE And Subsection IWL", states "The third modification, 50.55a(b)(2)(x)(C), makes the Subsection IWE pressure retaining welds and Subsection IWE pressure retaining dissimilar metal welds inspection optional. The NRC staff concludes that requiring these inspections is not appropriate. There is no evidence of problems associated with welds of this type in operating plants. Therefore, the occupational radiation exposure that would be incurred while performing these inspections cannot be justified. It is estimated that the total occupational exposure that would be incurred yearly in the performance of the containment weld inspections would be 440 person-rems."

Question 296

LRA Section 3.5.2.2.2.1

NRC Issue

LRA Section 3.5.2.2.2.1, Item 8 – (a) Explain how the elevated temperature on internal concrete components, where the temperature could approach 150 F, are addressed by BFN Civil Design Criteria, (b) Discuss the evaluation of the drywell concrete structure for thermal effects, (c) Discuss the technical basis for concluding that “the upper elevations of the sacrificial shield wall may exceed 150 F briefly and infrequently, during abnormal operations and is not considered to affect its functions,” (d) Discuss the local temperatures that can be expected in the concrete surrounding hot piping penetrations and what provisions exist for maintaining these temperatures within acceptable limits. This question also applies to

Precedent RC-2b (LRA Table 3.5.2.1, Row No. 25) and Precedent RC-4b (all applicable LRA Table 3.5 items).

TVA Response

The BFN general design criteria document, BFN-50-C-7100 "Design of Civil Structures" (DC), provides the design basis requirements for all BFN structures, including the primary containment. In section 3.2.5 of Appendix C to the DC, the temperature requirements are defined for the drywell concrete, with an operating temperature of 150 F specified for the drywell.

Table 15-10, "Reactor Support Pedestal Design Data", of Appendix C to the DC provides the principal design cases for the reactor support pedestal and includes the requirement to consider thermal effects for each principal design case. Table 15-12, "Reactor Building Concrete Structure Fuel Pool Storage Pool and Dryer/Separator Storage Pool Design Data" of Appendix C to the DC requires the consideration of drywell thermal rise for the appropriate principal design cases for the spent fuel storage pool and dryer/separator storage pool of the Reactor Building. Both these pools have structural elements that form portions of the outer structural concrete shell of the primary containment steel shell.

Table 15-15(a), "Drywell Concrete Structure" of Appendix C to the DC provides the principal design cases for the drywell concrete and requires the consideration of thermal in the principal loading combinations for the drywell concrete structure.

The sacrificial shield wall provides a biological shield for protection of personnel from gamma radiation, a neutron shield to prevent activation of the drywell components during operation, and a means of supporting the drywell pipe hangers and access platform. It also provides protection against damage to the nuclear system process barrier due to seismic loading, and against further damage due to vessel pipe penetration rupture jet forces and a limit stop and support for pipe restraints in the event of a drywell pipe rupture. It consists of a 24 foot diameter circular cylinder attached to the vessel support pedestal and extending upward approximately 45 feet. The sacrificial shield wall is 27 inches thick and is constructed from 26 inch vertical WF beam columns, tied together by horizontal WF beams and 1/4 inch plates.

These ¼ inch plates are welded to the column flanges, both inside and outside, thereby forming a double walled shell. This shell is filled with concrete to provide biological shielding capability. The concrete shall be assumed to have no structural purpose, except for the lowest 10 feet 6 inches of the wall. Based on the design criterion that the concrete has no structural purpose except for the lowest 10.5 feet, it was concluded that "the upper elevations of the sacrificial shield wall may exceed the 150 F briefly and infrequently during abnormal operation and is not considered to affect its function" as stated in LRA 3.5.2.2.2.1, item 8.

Aging management of loss of strength and modulus due to elevated temperature will be addressed by D-RAI-3.5-5.

Question 297

LRA Section 3.5.2.2.2.2

NRC Issue

LRA Section 3.5.2.2.2.2 – Provide the results of the BFN groundwater and Wheeler Reservoir water samples. Explain how often and under what existing program these samples are taken. As discussed in GALL, periodic monitoring of below-grade water chemistry (including consideration of potential seasonal variations) is an acceptable approach to demonstrate that the below-grade environment is aggressive or non-aggressive. If there is no program for periodic monitoring of groundwater, please explain the BFN approach for aging management of below-grade exterior concrete in inaccessible areas. This question also applies to the following Precedent RC-1a Items:

LRA Table 3.5.2.2, Row Nos. 43, 44
LRA Table 3.5.2.3, Row Nos. 15, 6
LRA Table 3.5.2.5, Row Nos. 42, 43
LRA Table 3.5.2.6, Row Nos. 8, 9
LRA Table 3.5.2.7, Row Nos. 7, 8
LRA Table 3.5.2.8, Row Nos. 10, 11
LRA Table 3.5.2.9, Row Nos. 11, 12
LRA Table 3.5.2.10, Row Nos. 10, 11
LRA Table 3.5.2.12, Row Nos. 19, 20
LRA Table 3.5.2.17, Row Nos. 5, 6, 22, 23
LRA Table 3.5.2.18, Row Nos. 4, 5
LRA Table 3.5.2.19, Row Nos. 15, 6
LRA Table 3.5.2.20, Row Nos. 17, 18
LRA Table 3.5.2.22, Row Nos. 4, 5
LRA Table 3.5.2.24, Row Nos. 5, 6
LRA Table 3.5.2.25, Row Nos. 5, 6

TVA Response

Since BFN did not have data available from the construction period or since plant start-up, baseline sampling was performed over the past year of groundwater and Wheeler Reservoir. The baseline sampling was to establish if BFN had aggressive or non-aggressive water as defined by the following criteria:

pH <5.5, Chlorides > 500 ppm and Sulfates > 1500 ppm. The samples were taken at intervals to take into consideration seasonal variations. The samples were taken from the existing site radiological monitoring wells and from the Wheeler Reservoir in close proximity to the Intake structure. Samples were taken at various depths in the monitoring well and the Reservoir by the site environment staff and analyzed by an off-site laboratory for the site environment group.

Results of Browns Ferry groundwater and Wheeler Reservoir water sampling are as follows:

Groundwater:

- pH - ranges from 6.33 to 8.77 which are well above <5.5 (Note in the well that the value 6.33 was obtained, the remaining readings ranged from 7.16 to 7.60 during the time period of sampling. Only one other well had a value below 7 and its pH was 6.92 with the remaining readings ranging between 7.12 and 7.60)

- Chlorides - maximum reading of 18.3 ppm which is well below the threshold of 500 ppm

- Sulfates - maximum reading of 30.3 ppm which is well below the threshold of 1500 ppm

Wheeler Reservoir:

- pH - ranges from 7.28 to 8.64 which are well above <5.5

- Chlorides – maximum reading of 13.9 ppm which is well below the threshold of 500 ppm

- Sulfates – maximum reading of 15.5 ppm which is well below the threshold of 1500 ppm

Browns Ferry groundwater water and Wheeler Reservoir sample measurements have confirmed that parameters are well below threshold limits that could cause concrete degradation (an aggressive environment does not exist). The rate of groundwater flow is not considered an aggressive flow rate.

Browns Ferry does not commit to periodic groundwater monitoring over the period of license extension, since it is not credible to postulate that some environmental event will occur in the future that would affect the quality of groundwater in the vicinity of Browns Ferry. A change in the environment due to a chemical release would be considered as an “abnormal event”. NUREG-1800, “Standard Review Plan for the Review of License Renewal Applications for Nuclear Power Plants,” states that aging effects from abnormal events need not be postulated specifically for license renewal.

Question 298

LRA Section 3.4.2.2.2

NRC Issue

In section 3.4.2.2.2 of the LRA the applicant states that for aging effect loss of material due to general, pitting, and crevice corrosion, BFN will implement the One Time Inspection Program

(Section B.2.1.29) to verify the effectiveness of the Chemistry Control Program (Section B.2.1.5). The GALL report recommends that the effectiveness of the chemistry control program should be verified to ensure that corrosion is not occurring via use of tools like plant action levels, PERs to shut specific systems down if actions levels were exceeded. The applicant during the second audit provided and audit team reviewed implementing procedure Chemical Instruction (CI-13.1, Chemistry program Revision 20) which implements chemistry control at primary water used in SP&C system. Please indicate in the operation of BFN in the past five years, if you have any instances of exceeding the action level II or III, and if so what corrective actions were required for those systems where you exceeded these limits.

TVA Response

A review of BFN PERs identified no instances of exceeding Action Level II or III limits within in the previous five years.

Question 300

LRA Section Table 3.4.1

NRC Issue

In Table 3.4.1, Item 11 (Summary table of SP&C Systems AMPs), for components External surface of aboveground condensate storage tank, the applicant indicates that the AMP B2.1.26, above ground carbon steel tanks is consistent with exceptions. In actuality this AMP B2.1.26 does not request any exceptions (LRA Appendix B) and this table entry needs to be corrected.

TVA Response

The words "with exception" should not appear in the discussion column of Table 3.4.1, Item 11. Aging management program B2.1.26, Aboveground Carbon Steel Tanks Program is consistent with GALL.

Question 301

LRA Section Table 3.4.2.2

NRC Issue

Item 13, in AMR systems Table 3.4.2.2 for component expansion joints, material stainless steel with treated water internally, the project team asked the applicant if these metallic expansion joints were subjected to any appreciable thermal movements that could lead to joints cracking that would lead to crack initiations. The applicant said that there were no appreciable movements which please confirm. Please also indicate the specific location of the component in the SP&C system.

TVA Response

The Condensate System metallic expansion joints are in the headers from the Condensate Storage Tanks to the Reactor and Turbine Buildings. The Condensate Storage Tanks are located outside and the headers where the expansion joints are located are in a concrete tunnel. This header has flow when makeup is being supplied to the Condensate System and during testing of the HPCI, RCIC, and Core Spray Pumps.

The tunnel where these headers are located is not temperature controlled and the temperature differences between the storage tank and header will be minimal. The expansion joints meet the same design criteria as the headers and therefore, fatigue of these expansion joints is bounded by the TLAA evaluation in the BFN LRA, Section 4.3.3.

Question 304

LRA Section Table 3.4.2.2

NRC Issue

Item 35, in AMR Table 3.4.2.2, material carbon and low alloy steel, air/gas environment, GALL specifies Chemistry control prior to the one time inspection B2.1.29 identified in the LRA. The applicant mentions only one time inspection and the audit team wanted to know why? The environment is no-brainer i.e. Air/gas, and is there something in the nature of the components that warrants B.2.1.29?

TVA Response

GALL Table VIII.E.1, Condensate System, does not address the air/gas environment identified in the BFN LRA. The Chemistry Control Program does not provide a method for controlling lines that are dry or partially dry. Chemistry control only applies to treated water environments. In particular, the item 35 environment in the BFN LRA, Table 3.4.2.2 is referring to the area between the two isolation valves on Condensate System vents and drains. This small segment of piping is exposed to condensate flow when the valves are open and has trapped air with varying amount of condensate based on how the valves are closed, i.e., the sequence and time between closing the valves. The safety consequences for this short segment of piping failing are non-existent as this line is downstream of a closed isolation valve. However, for completeness, BFN will perform inspections to verify these lines are not degrading using the One-Time Inspection Program.

Question 309

LRA Section n/a

NRC Issue

With regards to Mechanical Precedent Comparison Tables (27 pages) available to the project team during the AMR audit, St. Lucie LRA Table 3.4-3 has been referenced for carbon steel-lubricating oil environment combination for CS-6a item. The corresponding SER section 3.4.2.1 discusses aging effects and provides technical justifications why the staff accepted these specific LRA table items. However, the SER did not include technical justifications for all items in the St. Lucie LRA table, including CS-6a. Therefore, discuss with technical justifications why this item does not have any aging effects. Also, explain how BFN has used the St. Lucie LRA table and its SER to reach this conclusion.

TVA Response

Lubricating oil systems generally do not suffer appreciable degradation by cracking or loss of material since the environment is not conducive to corrosion mechanisms. In addressing the question, "Is there a potential for water contamination?" plant experience (i.e., maintenance/operating history) is utilized as a basis for conclusions reached. The lubricating oil applications where there is no history of water contamination do not have any potential aging mechanisms. Those applications where water contamination does occur, such as the diesel generator combustion air intake filters, have loss of material identified.

Question 310

LRA Section Table 3.5.2.26

NRC Issue

Precedent CS-2a (LRA Table 3.5.2.26, Row No. 3) – For the high strength bolts includedunder this item, describe the bolting material, the nominal and as-built yield strengths, and the hardness of the material. Discuss the BFN disposition of the recommendations for a comprehensive bolting integrity program, as delineated in NUREG-1339, and industry recommendations, as delineated in EPRI NP-5769.

TVA Response

The only high strength structural bolting (ultimate tensile strength [UTS] > 150 ksi) material specified for use at BFN is ASTM A-490 (Ref. General Engineering Specification G-29B-S01, PS 4.M.4.4, "ASME Section III and Non-ASME Section III (including AISC, ANSI B31.1, and ANSI B31.5) Bolting Material"). The ultimate tensile strength for A-490 bolting ½" to 1 ½" may vary between 150 to 170 ksi, a minimum yield strength of 130 ksi is specified and hardness may vary from 33 to 38 Rockwell C (ASTM A-490 Standard).

The Bolting Integrity Program manages loss of material of mechanical component steel bolting within the scope of License Renewal. ASME Section XI manages aging of structural bolting (encompassed by 'Support members; welds; bolted connections; support anchorage to building structure') for ASME equivalent supports. Structures Monitoring Program manages aging of structural bolting for the remaining structural supports within the scope of License Renewal. The support components, including the bolting, are periodically inspected for loss of material by these programs.

High strength bolting (UTS >150 ksi) is not considered susceptible to cracking due to stress corrosion cracking at BFN. For SCC to manifest in high strength bolting, an aggressive chemical or wetted environment is required in addition to susceptible material and high tensile stresses. High strength bolting (UTS >150 ksi) used in ASME equivalent supports at BFN are installed in indoor air environments that are not exposed to aggressive chemicals, periodic wetting, or splash zones. Additionally, high strength bolting is used for Unit 1 drywell floor steel framing and other structural purposes to connect the RPV skirt flange to the top flange of the ring girder in the drywell and these bolts are exposed to a containment atmosphere environment in the drywell not subject to aggressive chemicals, periodic wetting or splash zones. As noted below, thread lubricants are also controlled to eliminate corrosive environmental effects. Therefore an aggressive chemical or wetted environment does not exist.

Per the EPRI Mechanical and Structural Tools and EPRI NP-5769, high strength bolting is considered susceptible to SCC in a corrosive environment with the use of thread lubricants containing molybdenum disulfide. Approved thread lubricants for use in bolted joints at BFN are specified in General Engineering Specification (GES) G-29B-S01 PS 4.M.1.1 and section 3.9.2 notes that lubricants containing molybdenum disulfide shall not be used.

Structural bolting procurement activities, receipt inspection and installation (torquing), as defined in TVA procedure GES G-29B-S01, P.S.4.M.4.4, 'ASME Section III and Non-Section III (Including AISC, ANSI B31.1, and ANSI B31.5) Bolting Material', are considered part of TVA's Bolting Integrity Program and meet the industry recommendations for these activities as delineated in NUREG-1339 and EPRI NP-5769.

Question 311

LRA Section Table 3.5.2.26

NRC Issue

Precedent CS-4c (LRA Table 3.5.2.26, Row No. 2) – The program comparison CS-C states that only the BFN aging mechanisms of loss of material due to general corrosion and the related loss of mechanical function due to corrosion are considered applicable. Please provide the technical basis for concluding that other aging mechanisms are not applicable. The program comparison CS-C also states that the BFN program takes exceptions to GALL regarding the inspections of Class MC component supports. These exceptions are not acceptable to the NRC project team and have been referred to NRC/DE for further review.

TVA Response

Table 3.5.2.26 row 2 applies to ASME equivalent Class 1 supports. The aging management review for the material and environment combination of carbon steel in an inside air environment was performed and concluded that the only plausible aging mechanisms needing managing were:

- Loss of material due to general corrosion
- Loss of mechanical function due to corrosion, distortion, dirt, overload, and fatigue due to vibratory and cyclic thermal loads

The ASME Section XI, Subsection IWF will be used to manage these aging effects of loss of material and loss of mechanical function identified in Table 3.5.2.26 row 2.
The referenced table row applies to ASME equivalent Class 1 supports and is not applicable to Class MC supports. The response to D-RAI-3.5-6 will address AMR related to Class MC supports.

Question 312

LRA Section Table 3.5.2.26

NRC Issue

Precedent CS-5a (LRA Table 3.5.2.26, Row No. 9) – The program comparison CS-D states that only the BFN aging mechanisms of loss of material due to general corrosion, crevice corrosion and pitting corrosion are considered applicable. Please provide the technical basis for concluding that other aging mechanisms are not applicable. The program comparison CS-D also states that the BFN program takes exceptions to GALL regarding the inspections of Class MC component supports. These exceptions are not acceptable to the NRC project team and have been referred to NRC/DE for further review.

TVA Response

Table 3.5.2.26 row 9 applies to ASME equivalent Class 2 and 3 supports. The aging management review for the material and environment combination of carbon steel in an outside air environment was performed and concluded that the only plausible aging mechanism needing managing was:

- Loss of material due to general, crevice and pitting corrosion.

The ASME Section XI, Subsection IWF will be used to manage the aging effect of loss of material identified in Table 3.5.2.26 row 9.

The referenced table row applies to ASME equivalent Class 2 and 3 supports and is not applicable to Class MC supports. The response to D-RAI-3.5-6 will address AMR related to Class MC supports.

Question 313

LRA Section n/a

NRC Issue

The project team discussed with BFN staff all items that do not have any past precedence as noted in the Mechanical Precedent Comparison Table. During the discussion, the items SS-8e, SS-9i, and CS-9m required further information. Provide technical justifications why these items do not have any aging effects.

TVA Response

SS-8e Stainless Steel/Raw Water/Cracking

This precedent is used in the following tables:

Table 3.3.2.7, Potable Water System identifies cracking in potable (raw) water. This aging mechanism is not applicable o this material/environment combination. Therefore, SS-8e is not applicable to Table 3.3.2.7.

Table 3.3.2.9, Heating, Ventilation, and Air Conditioning identifies cracking in potable (raw) water. This aging mechanism is not applicable to this material/environment combination. Therefore, SS-8e is not applicable to Table 3.3.2.9.

With these corrections in the aging management review tables, SS-8e is not applicable to the BFN LRA.

SS-9i Stainless Steel/Treated Water/Loss of Material

This precedent is used in the following table:

Table 3.1.2.4, Reactor Recirculation System, identifies loss of material in treated water with One-Time Inspection identified as the aging management program. The appropriate aging management programs are the Chemistry Control Program and the One-Time Inspection Program as discussed in Question 397. Therefore, SS-8e is not applicable to Table 3.1.2.4.

With these corrections in the aging management review tables, SS-9i is not applicable to the BFN LRA.

CS-9m Carbon and Low Alloy Steel/Treated Water/Loss of Material

This precedent is used in the following tables:

Table 3.3.2.1, Auxiliary Boiler System, identifies loss of material in treated water with

One-Time Inspection identified as the aging management program. The treated water in the Auxiliary Boiler System is secondary quality water that has been isolated by the lay-up of the auxiliary boilers. Once this water becomes isolated the chemistry can no longer be controlled and verified. Since the portions of the Auxiliary Boiler System exposed to treated water was originally chemistry controlled, the potential for corrosion is low. The One-Time Inspection Program will verify this by performing a sampling inspection. If corrosion is detected that indicates that operation during the period of extended operations may be affected, then additional inspections and corrective actions are required by the One-Time Inspection Program.

Table 3.3.2.25, Radioactive Waste Treatment System, identifies loss of material in treated water with One-Time Inspection identified as the aging management program. As previously addressed in question 362, the treated water in the Radioactive Waste Treatment System is waste that was generated from systems that primarily contain chemistry control treated water; however, once this water becomes a waste stream, the chemistry can no longer be controlled. Since the portions of the system exposed to treated water have their primary water source from chemistry control systems, the potential for corrosion is low and the One-Time Inspection Program will verify this by performing a sampling inspection. If corrosion is detected that indicates that operation during the period of extended operations may be affected, then additional inspections and corrective actions are required by the One-Time Inspection Program.

Question 355

LRA Section n/a

NRC Issue

Precedent SS-2a, SS-4a, SS-4b and SS-5b (All applicable LRA Table 3.5 items) – Provide the technical basis for concluding that the BFN stainless steel components included under the applicable Table 3.5 items do not require aging management for any aging effects/mechanisms in containment atmosphere, inside air and outside air environments.

TVA Response

The AMR evaluation for stainless steel in the following environments; containment atmosphere, inside air and outside air, determined that stainless steel is not susceptible to loss of material in for these environments. Stainless steels form a passive film that prevents corrosion. Only a corrosive wetted environment is conducive to promoting aging degradation of stainless steel. Alternate wetting and drying in an outside air environment has shown a tendency to ‘wash’ the exterior surfaces, cleaning the surface rather than concentrating any corrosive contaminants (ref EPRI 1003056 Mechanical Tools). SCC of stainless steel is only considered plausible in wetted corrosive environments greater than 140 F that will not occur in the containment atmosphere environment, an inside air environment or an outside air environment.

ASME equivalent Class 1, Class 2, and Class 3 stainless steel supports are subject to the requirements of ASME Section XI, Subsection IWF during the period of extended operation.

<u>Question</u> 356

<u>LRA Section</u> Table 3.5.2.2

<u>NRC Issue</u>

Precedent SS-3a (LRA Table 3.5.2.2, Row Nos. 38, 58) – It is recognized that all metals embedded/encased in concrete are inaccessible; however, they could be susceptible to aging degradation. Please provide an AMR for further evaluation of embedded/encased components if aging of components in accessible areas is identified that may indicate aging of the inaccessible components.

<u>TVA Response</u>

The following stainless steel components that are embedded/encased are identified:

- Mechanical penetrations
- Spent fuel pool liners

The BFN concrete structures and concrete components are designed in accordance with ACI 318-63 and 71 and constructed using ingredients conforming to ACI and ASTM standards, which provide for a good quality, dense, well cured, and low permeability concrete. Cracking is controlled through proper arrangement and distribution of reinforcing bars.

Concrete structures and concrete components are constructed of a dense, well-cured concrete with an amount of cement suitable for strength development, and achievement of a water-to-cement ratio that is characteristic of concrete having low permeability. This is consistent with the recommendations and guidance provided by ACI 201.2R-77.

The aging management review for the material and environment combination of stainless steel in an embedded/encased environment was performed and concluded that no aging mechanism was identified that requires management.

Note that the submerged surfaces of spent fuel pool liners are managed by the chemistry control program and monitoring of the spent fuel pool level by plant operations.

A review of Browns Ferry operating history did not reveal any loss of intended function due to aging effects for stainless steel mechanical penetrations or spent fuel pool liners that are embedded/encased in concrete.

Question 357

LRA Section Table 3.5.2.21

NRC Issue

Precedent SS-6a (LRA Table 3.5.2.21, Row No. 28) – This item credits the Structures Monitoring Program (SMP) for managing the effects of loss of material due to crevice corrosion and pitting corrosion for stainless steel beams, columns, plates and trusses in a submerged environment. Identify the components included in this item, where they are located and the submerged environment. Describe the types of inspections that will be performed under the SMP for these components and whether these inspections are included in the current scope of the SMP. Provide the technical basis for not monitoring water chemistry.

TVA Response

LRA Table 3.5.2.21 row 28 applies to submerged portions of the stainless steel debris screen under the Diesel HP Fire Pump House. The intended functions of the debris screen are debris protection and non-safety related structural support. The miscellaneous components portion of the Structures Monitoring Program will be enhanced to visually inspect the submerged portions of the debris screen for loss of material due to crevice and pitting corrosion. Portions of the Diesel HP Fire Pump House debris screen are submerged in raw water environment, therefore monitoring of water chemistry is not applicable as an AMP.

Question 358

LRA Section Table 3.5.2.26

NRC Issue

Precedent SS-6b (LRA Table 3.5.2.26, Row No. 11) – Identify the ASME equivalent supports and components included in this item, where they are located and the submerged environment. Provide the BFN aging management review for this item and discuss the technical basis for not crediting ASME Section XI, Subsection IWF as the aging management program.

TVA Response

LRA Table 3.5.2.26 row 11 applies to the stainless steel ASME equivalent Class 2 supports for the SRV discharge lines that are in the submerged environment of the suppression pool water. The Chemistry Control Program and a One Time Inspection will manage loss of material for stainless steel ASME equivalent Class 2 supports exposed in a submerged treated (suppression pool) water environment. These lines are exempt from inspection per ASME Section XI.

Question 359

LRA Section Table 3.5.2.12

NRC Issue

Precedent RC-6a (LRA Table 3.5.2.12, Row Nos. 37, 38) – The fact that a component is submerged does not, by itself, make it inaccessible. Please identify all the submerged concrete components in the Intake Pumping Station and provide the technical basis for designating these components as being inaccessible. If the component is not inaccessible, it is expected that the components will be managed by the Inspection of Water Control Structures Program (B.2.1.37). The exceptions in GALL IIIA6.1-d and apply only to interior and above-grade exterior concrete. Please identify all the submerged concrete structures that will be inspected under the B.2.1.37 AMP. Furthermore, please describe the implementing details of the inspection of submerged structures included in the B.2.1.37 AMP.

TVA Response

Browns Ferry groundwater water and Wheeler Reservoir water sample measurements presented in the response to question 297 have confirmed that parameters are well below threshold limits that could cause concrete degradation (an aggressive environment does not exist). It is not credible to postulate that some environmental event will occur in the future that would affect the quality of groundwater in the vicinity of Browns Ferry. A change in the environment due to a chemical release would be considered as an “abnormal event”. NUREG-1800, “Standard Review Plan for the Review of License Renewal Applications for Nuclear Power Plants,” states that aging effects from abnormal events need not be postulated specifically for license renewal.

In-scope submerged concrete exposed to Wheeler Reservoir water is not readily accessible for inspection. Several in-scope submerged concrete common areas outside of individual pump bays where continuous flow make diver entry unsafe would require a multiple unit outage to inspect. Browns Ferry will perform a one time inspection of the in-scope submerged concrete in one individual pump bay to confirm the absence of aggressive environmental aging effects and that a loss of intended function has not occurred due to aggressive environment aging effects.

Browns Ferry will also continue to perform periodic inspections of accessible concrete in an inside air environment and outside air environment for in-scope structures with the Structures Monitoring Program.

Question 360

LRA Section n/a

NRC Issue

The BFN LRA identifies crack initiation/growth due to cyclic loading as an aging effect requiring management for various mechanical components in the Auxiliary Systems and Engineered Safety Feature Systems. Examples include the Reactor Water Cleanup System (Table 3.3.2.21), the Sampling and Water Quality System (Table 3.3.2.14), the Reactor Core Isolation Cooling System (Table 3.3.2.23), the Standby Liquid Control System (Table 3.3.2.18), the Neutron Monitoring System (Table 3.3.2.32), the High Pressure Coolant Injection System (Table 3.2.2.3), the Residual Heat Removal System (Table 3.2.2.4), and the Core Spray System (Table 3.2.2.5). The ASME ISI program and One-Time Inspection program are credited to manage this aging effect and consistency with LRA Table 1 item 3.1.1.7 is claimed. However, Table 1 item 3.1.1.7 identifies the Water Chemistry program, in addition to the ASME ISI program and One-Time Inspection program for managing this aging effect. What is the technical basis for not including the Water Chemistry program to manage crack initiation/growth due to cyclic loading for these components?

TVA Response

GALL Volume 1, Table 1 specifies that that consistency with GALL Volume 2, Line IV.C1.1-i establishes consistency with GALL Volume 1, Table 1, Item 3.1.1.7. Previous to the Browns Ferry LRA, all license renewal applications have been written at the aging effect level and did not address aging mechanisms. The primary difficulty in determining GALL line item consistency is that the aging management programs should be consistent with the aging effects listed, not necessarily with the individual aging mechanisms listed. Therefore when reviewing the aging mechanism "crack initiation/growth due to cyclic loading" instead of the aging effect "crack initiation/growth," some interpretation of the GALL line item was required.

GALL Item IV.C1.1-i addresses specific concerns with small bore piping and fittings less than NPS 4. The GALL line item provides a comprehensive listing of potential aging mechanisms and aging management programs for the crack initiation and growth aging effect. To address that all materials and aging management programs are not applicable to each aging mechanism, this GALL line item was interpreted follows for the various materials and aging mechanisms.

Stainless steel/Treated water (Note 1)

Aging Effect

- Crack initiation and growth/ Stress corrosion cracking, inter-granular stress corrosion cracking

Aging Management Programs

- ASME Section XI Subsections IWB, IWC and IWD Inservice Inspection Program (B.2.1.4)
- Chemistry Control Program (B.2.1.5)
- One-Time Inspection Program (B.2.1.29)

<u>Stainless steel/Treated water (Note 2)</u>

Aging Effect

- Crack initiation and growth/ Thermal and mechanical loading

Aging Management Programs

- ASME Section XI Subsections IWB, IWC and IWD Inservice Inspection Program (B.2.1.4)
- One-Time Inspection Program (B.2.1.29)

<u>Carbon steel/Treated water (Note 3)</u>

Aging Effect

- Crack initiation and growth/ Stress corrosion cracking, inter-granular stress corrosion cracking

Aging Management Programs

- None

<u>Carbon steel/Treated water (Note 4)</u>

Aging Effect

- Crack initiation and growth/ Thermal and mechanical loading

Aging Management Programs

- ASME Section XI Subsections IWB, IWC and IWD Inservice Inspection Program (B.2.1.4)
- One-Time Inspection Program (B.2.1.29)

NOTES:

1. For crack initiation and growth due to stress corrosion cracking and inter-granular stress corrosion cracking of stainless steel, the three aging management programs included in GALL line item IV.C1.1-i are applicable and are specified by the Browns Ferry LRA.

2. For crack initiation and growth due to thermal and mechanical loading of stainless steel, continued application of cyclic stresses can produce crack growth once a crack or crack-like flaw has initiated. This is a purely mechanical function and is not managed or mitigated by the Chemistry Control Program. The purpose of these examinations is to identify flaws that may lead to unstable crack growth in the pressure boundary during service. The welds in the piping and fittings are basically the same material as one or both of the parts being joined and are regarded as having higher potential for flaws than base material to experience flaw growth during plant operation. Therefore, the ASME Section XI Subsections IWB, IWC and IWD Inservice Inspection Program focuses on welds and a One-Time Inspection Program augments the ASME Section XI Subsections IWB, IWC and IWD Inservice Inspection Program for verifying that service-induced cracking is not occurring in the small-bore piping less than NPS 4.

3. For crack initiation and growth due to stress corrosion cracking and inter-granular stress corrosion cracking of carbon and low alloy steels, no aging management programs are applicable as carbon and low alloy steels are not susceptible to stress corrosion cracking in this application.

4. For crack initiation and growth due to thermal and mechanical loading of carbon and low alloy steels, continued application of cyclic stresses can produce crack growth once a crack or crack-like flaw has initiated. This is a purely mechanical function and is not managed or mitigated by the Chemistry Control Program. The purpose of these examinations is to identify flaws that may lead to unstable crack growth in the pressure boundary during service. The welds in the piping and fittings are basically the same material as one or both of the parts being joined and are regarded as having higher potential for flaws than base material to experience flaw growth during plant operation. Therefore, the ASME Section XI Subsections IWB, IWC and IWD Inservice Inspection Program focuses on welds and a One-Time Inspection Program augments the ASME Section XI Subsections IWB, IWC and IWD Inservice Inspection Program for verifying that service-induced cracking is not occurring in the small-bore piping less than NPS 4.

Question 361

LRA Section n/a

NRC Issue

Table 3.3.2.25 of the BFN LRA identifies loss of material due to MIC as an aging effect requiring management for components in a raw water environment in the Radioactive Waste Treatment system. Table 1 items 3.2.1.3, 3.2.1.5, and 3.2.1.6 are referenced and consistency with GALL is noted. The One-Time Inspection program is credited to manage this aging effect. However, 3.2.1.6 references the further evaluation in 3.2.2.2.4, which identifies the Open-Cycle Cooling Water Program for managing MIC. What is the technical basis for crediting the One-Time Inspection program for managing aging due to MIC for these components?

TVA Response

The raw water environment identified in the Radioactive Waste Treatment System is waste that was generated from floor and equipment drain sumps and may contain dirty or contaminated water. This waste stream is not subject to the Chemistry Control Program or The Open-Cycle Cooling Water Program. The potential for corrosion in this system would be lower than actual "raw water" systems because a portion of the waste stream would be treated water from chemistry control systems. BFN determined that inspection in accordance with the One-Time Inspection Program will verify integrity of this system during the period of extended operation Note, if corrosion is detected that indicates that operation during the period of extended operations may be affected, then additional inspections and corrective actions are required by the One-Time Inspection Program.

Question 362

LRA Section n/a

NRC Issue

The BFN LRA identifies loss of material due to crevice, general, and pitting corrosion as an aging effect requiring management for mechanical components in a treated water environment in the Radioactive Waste Treatment System (Table 3.3.2.25). Table 1 items 3.2.1.3 and 3.2.1.5 are referenced and consistency with GALL is noted. The One-Time Inspection program is credited for managing this aging effect. However, the further evaluation in the BFN LRA Section 3.2.2.2.2 identifies the Chemistry Control Program for managing the effects of corrosion for components in a treated water environment. What is the technical basis for using the One-Time Inspection program alone to manage aging due to corrosion for components in a treated water environment instead of the Chemistry Control program?

TVA Response

The treated water in the Radioactive Waste Treatment System is waste that was generated from systems that contain chemistry control treated water; however, once this water becomes a waste stream, the chemistry can no longer be controlled. Since the portions of the system exposed to treated water have their water source from chemistry control systems, the potential for corrosion is low and the One-Time Inspection Program will verify this by performing a sampling inspection. If corrosion is detected that indicates that operation during the period of extended operations may be affected, then additional inspections and corrective actions are required by the One-Time Inspection Program.

Question 363

LRA Section 3.2.2.2.3

NRC Issue

The BFN LRA identified loss of material due to crevice and pitting corrosion as an aging effect requiring management for mechanical components in a treated water environment in the Radiation Monitoring System (Table 3.3.2.31). Table 1 item 3.2.1.5 is referenced and consistency with GALL is noted. The Closed-Cycle Cooling Water program is credited for managing this aging effect. However, the further evaluation in the BFN LRA Section 3.2.2.2.3 identifies the Chemistry Control and One-Time Inspection programs for managing the effects of corrosion for components in a treated water environment. What is the technical basis for using the Closed-Cycle Cooling Water program alone to manage aging due to corrosion for components in a treated water environment instead of the Chemistry Control and One-Time Inspection programs?

TVA Response

The BFN Closed-Cycle Cooling Water Program is consistent with the related GALL Closed-Cycle Cooling Water Program (XI.M21). The BFN Closed-Cycle Cooling Water Program provides for prevention and detection of aging effects in plant closed-cycle cooling water systems. BFN LRA Section 3.2.2.2.3 only addresses treated water environments and should include a discussion of the Closed-Cycle Cooling Water Program for treated water in closed cooling loops.

Question 364

LRA Section Table 3.5.2.26

NRC Issue

Table 3.5.2.26, Row Nos. 3, 5, 6, 10, 11, 14, 15, 16 and 18 - These items, which pertain to ASME Equivalent Supports and Components, do not credit the ASME Section XI, Subsection IWF Program as an aging management program for license renewal. It is the staff's understanding that these supports are required to be inspected under IWF for the CLB. Please explain why this commitment would not continue for the extended period of operation.

TVA Response

These ASME equivalent supports and components will continue to be inspected consistent with the commitments contained in the Browns Ferry CLB for the ASME Section XI subsection IWF Program requirements in effect during the extended period of operation. The specific reference to row nos. noted in the question, except for row no. 11, all had material and environmental combinations that upon performing the aging management review, it was determined that there were no aging effects that required managing for license renewal.

Row no. 11 applies to ASME equivalent Class 2 supports of stainless steel material in a submerged (suppression pool water) environment. The Chemistry Control Program and a One Time Inspection will manage loss of material for stainless steel ASME equivalent Class 2 supports exposed in a submerged (suppression pool water) environment. The stainless steel ASME equivalent Class 2 supports in a submerged (suppression pool water) environment are exempt from inspection per ASME Section XI.

Question 365

LRA Section Table 3.5.2.1

NRC Issue

Table 3.5.2.1, Row Nos. 4, 6, 8 and 10 - For these items, the BFN LRA credits the Appendix J Program. The GALL also expects that the Plant Technical Specifications will be credited. Please identify these items and explain the BFN Plant Technical Specifications that govern the leakage testing of these items after each opening.

TVA Response

Table 3.5.2.1, row numbers 4 and 6 apply to the drywell personnel access airlock. Table 3.5.2.1, row numbers 8 and 10 apply to the torus and drywell access hatches and equipment hatches. These containment pressure boundary components will continue to be inspected consistent with the Browns Ferry CLB Technical Specifications for Appendix J requirements. BFN Technical Specification Requirements, Section 5.5.12 "Primary Containment Leakage Rate Testing Program" provides for the requirement to establish a program to implement the leakage rate testing of the containment as required by 10 CFR 50.54(o) and 10CFR 50, Appendix J and provides the leakage rate acceptance criteria of the program.

Question 366

LRA Section Table 3.5.2.1

NRC Issue

Table 3.5.2.1, Row No. 1 - Please identify the caulking and sealants included under this item and clarify why Appendix J is not a credited AMP.

TVA Response

Table 3.5.2.1, Row No. 1 applies to the moisture barrier seal between the drywell steel shell and the concrete floor at EL. 549.92' in the bottom of the drywell. Appendix J testing is not required since the drywell floor moisture barrier seal between drywell steel shell and EL. 549.92' concrete does not have a pressure boundary function.

<u>Question</u> 367

<u>LRA Section</u> Table 3.5.2.12

<u>NRC Issue</u>

Table 3.5.2.12, Row Nos. 41 and 42; Table 3.5.2.13, Row Nos. 4, 5, 6, 7 and 8; Table 3.5.2.26, Row Nos. 19 and 20 - Please identify each of the components included in the referenced LRA Tables and Row Nos. and explain the reference to Note C.

<u>TVA Response</u>

Table 3.5.2.1.12, row numbers 41 and 42 apply to security barrier steel framing at the Intake Pumping Station. Note C was used because the security barrier steel framing was evaluated with structural steel beams columns and trusses (steel components) commodity group.

Table 3.5.2.13, row numbers 4, 5, 6, 7, and 8 apply to concrete that is sandwiched between the steel sheet pile cells of Gate Structure Number 3. Note C was used because the concrete sandwiched between the steel sheet pile cells was evaluated with concrete elements that were not sandwiched between steel sheet piles.

Table 3.5.2.26, row numbers 19 and 20 apply to cable trays and supports in containment atmosphere and inside air environments. Note C was used because cable trays were evaluated with the cable tray supports.

<u>Question</u> 368

<u>LRA Section</u> Table 3.5.2.12

<u>NRC Issue</u>

Table 3.5.2.12, Row No. 34 - Explain the extent to which the referenced submerged structures are inspected for the effects of freeze-thaw under the Inspection of Water-Control Structures Program.

<u>TVA Response</u>

The referenced submerged structure will be inspected for the effects of freeze-thaw at the waterline where icing conditions could occur.

<u>Question</u> 369

<u>LRA Section</u> Table 3.5.2.2

NRC Issue

Table 3.5.2.2, Row No. 61 - Please describe the AMR for boral and clarify whether stainless steel components are used to support the boral. If the AMR supports the conclusion that boral does not require aging management, but the stainless steel supports do, then the Chemistry Control Program would be an acceptable AMP for this item. If not, please provide the technical basis for crediting the Chemistry Control Program as the appropriate AMP for boral.

TVA Response

The Boral core is made up of a central segment of a dispersion of boron carbide in aluminum. This central segment is clad on both sides with aluminum to form a plate. The Boral plates are sandwiched between two stainless steel plates that form the container, which are closure welded. Vent holes have been added to prevent the buildup of hydrogen gas between the stainless steel containers. If the stainless steel containers remain intact, the boral core will be unaffected and will retain its neutron absorbing capacity. The chemistry control program will manage aging of the stainless steel container.

Question 388

LRA Section Table 3.3.2.21

NRC Issue

The BFN LRA Table 3.3.2.21 includes several entries that identify loss of material due to corrosion for stainless steel components in a treated water environment as an aging effect requiring management. The Closed Cooling Water System Program is credited for managing this aging effect and consistency with LRA Table 1 item 3.2.1.5 is claimed. However, Table 1 item 3.2.1.5 references the further evaluation in LRA 3.2.2.2.3, which states that Chemistry Control and One-Time inspection are used to control loss of material for this material/environment combination. What is the technical basis for selecting the Closed-Cycle Cooling Water program for these components and why is LRA Table 1 item 3.2.1.5 referenced?

TVA Response

The BFN Closed-Cycle Cooling Water Program is consistent with the related GALL Closed-Cycle Cooling Water Program (XI.M21). The BFN Closed-Cycle Cooling Water Program provides for prevention and detection of aging effects in plant closed-cycle cooling water systems. BFN LRA Section 3.2.2.2.3 only addresses treated water environments and should include a discussion of the Closed-Cycle Cooling Water Program for treated water in closed cooling loops.

Question 389

LRA Section Tables 3.3.2.5, 3.3.2.14, 3.3.2.21, 3.3.2.25, and 3.3.2.31

NRC Issue

The BFN LRA Tables 3.3.2.5, 3.3.2.14, 3.3.2.21, 3.3.2.25, and 3.3.2.31 identify loss of material due to biofouling, MIC, crevice corrosion, general corrosion, and pitting corrosion as an aging effect requiring management for stainless steel components in a raw water environment. Table 1 items 3.2.1.3, 3.2.1.5, and 3.2.1.6 are referenced and consistency with GALL is noted. Table 1 items 3.2.1.3, 3.2.1.5 and 3.2.1.6 reference further evaluations in 3.2.2.2.2. 3.2.2.2.3, and 3.2.2.2.4, respectively. However, 3.2.2.2.2 and 3.2.2.2.3 pertain to components in treated water, for which the Chemistry Control and One-Time Inspection Programs are identified. Only 3.2.2.2.4 pertains to components in raw water. Why are Table 1 items 3.2.1.3 and 3.2.1.5 referenced for these components? Also, what is the technical basis for using the One-Time Inspection program to manage aging due to MIC for the components in Table 3.3.2.25 instead of the Open-Cycle Cooling Water program?

TVA Response

The BFN Open-Cycle Cooling Water Program is consistent with the related GALL Open-Cycle Cooling Water Program (XI.M20). The BFN Open-Cycle Cooling Water Program provides for prevention and detection of aging effects in plant open-cycle cooling water systems. BFN LRA Sections 3.2.2.2.2 and 3.2.2.2.3 only addresses treated water environments and should include a discussion of the Open-Cycle Cooling Water Program for raw water systems.

Question 390

LRA Section Table 3.3.2.28

NRC Issue

The BFN LRA Table 3.3.2.28 identifies elastomer degradation due to thermal exposure as an aging effect requiring management for flexible connectors in an air/gas environment. Consistency with Table 1 item 3.3.1.2 is noted and the One-Time Inspection program is credited for managing this aging effect. However, Table 1 item 3.3.1.2 references the further evaluation in 3.3.2.2.2, which states that elastomer degradation will be managed by the Systems Monitoring program. Why is the One-Time Inspection credited here?

TVA Response

The One-Time inspection Program is credited for the inspection of elastomers where the degradation mechanism may be internal. The Systems Monitoring Program is credited for the inspection of elastomers where the degradation mechanism may be external. BFN LRA Sections 3.3.2.2.2 should include a discussion of the One-Time inspection Programfor internal surfaces of elastomers. If degradation is detected that indicates that operation during the period of extended operations may be affected, then additional inspections and corrective actions are required by the One-Time Inspection Program.

Question 391

LRA Section Table 3.3.2.28

NRC Issue

The BFN LRA Table 3.3.2.28 identifies loss of material due to crevice, general, and pitting corrosion as an aging effect requiring management for carbon and low alloy steel components in a treated water environment. Table 1 item 3.2.1.5 is referenced and consistency with GALL is noted. The Closed-Cycle Cooling Water program is credited for managing this aging effect. However, Table 1 item 3.3.1.5 references the further evaluation in 3.3.2.2.5, which pertains to components in an air environment, and does not include Closed-Cycle Cooling Water Program as one of the programs to manage aging. Why is 3.3.1.5 referenced for these components?

TVA Response

Table 3.3.2.28, Diesel Generator System, has six line items with a treated water environment that matches GALL. The correct GALL Volume 1, Table 1 reference for the items that match GALL is to Item 3.3.1.15. Five of the Table 3.3.2.28 treated water line items correctly reference 3.3.1.15, one incorrectly references 3.3.1.5. The reference to 3.3.1.5 should be 3.3.1.15.

Question 392

LRA Section n/a

NRC Issue

What kind of inspection will be performed during one-time inspection program implementation? Specifically for small bore piping (<4" NPS), Table 1 item 3.1.1.7. How the alternative of system leakage testing for NPS 1 RCS piping and smaller will adequately manage aging of small bore piping?

TVA Response

The BFN One-Time Inspection Program includes a sample inspection of Reactor Coolant Pressure Boundary piping less than four inch NPS exposed to reactor coolant for cracking.

The Browns Ferry One-Time Inspection Program provides the following description of how cracking will be detected.

"The inspection includes a representative sample of the system population, and, where practical, focuses on the bounding or lead components most susceptible to aging due to time in service, severity of operating conditions, and lowest design margin. For small-bore piping, actual inspection locations are based on physical accessibility, exposure levels, NDE techniques, and locations identified in Nuclear Regulatory Commission (NRC) Information Notice (IN) 97-46.

Combinations of NDE, including visual, ultrasonic, and surface techniques, are performed by qualified personnel following procedures consistent with the ASME Code and 10 CFR50, Appendix B. For small-bore piping less than NPS 4 in., including pipe, fittings, and branch connections, a plant-specific destructive examination of replaced piping due to plant modifications or NDE that permits inspection of the inside surfaces of the piping is to be conducted to ensure that cracking has not occurred. Follow-up of unacceptable inspection findings includes expansion of the inspection sample size and locations.

The inspection and test techniques prescribed by the program verify any aging effects because these techniques, used by qualified personnel, have been proven effective and consistent with staff expectations. With respect to inspection timing, the one-time inspection is to be completed before the end of the current operating license. The applicant may schedule the inspection in such a way as to minimize the impact on plant operations. However, the inspection is not to be scheduled too early in the current operating term, which could raise questions regarding continued absence of aging effects prior to and near the extended period of operation."

The One-Time Inspection Program implementing procedures have not been finalized at this time, but when completed will meet the program description provided in Browns Ferry LRA

<u>FOLLOWUP NRC QUESTION</u>:

What kind of NDE will be performed on <1" piping? Will the sampling include <1" lines?

<u>FOLLOWUP TVA RESPONSE</u>:

NUREG 1800, Aging Management Program XI.M32, One-Time Inspection, Evaluation and Technical Basis Section, Detection of Aging Effects, states:

> Combinations of NDE, including visual, ultrasonic, and surface techniques, are performed by qualified personnel following procedures consistent with the ASME Code and 10 CFR 50, Appendix B. For small-bore piping less than NPS 4 in., including pipe, fittings, and branch connections, a plant-specific destructive examination of replaced piping due to plant modifications or NDE that permits inspection of the inside surfaces of the piping is to be conducted to ensure that cracking has not occurred.

As noted from this paragraph, either destructive examination or NDE that is capable of detecting inside surface cracking is required. Since there are UT-inspectable, full penetration butt welds within scope of license renewal, BFN has chosen the second method for our program and no destructive examination of socket welds will be performed. Once this inspection methodology was selected, the possible sample population is full penetration butt welds. BFN has no identified butt welds in ASME Class 1 piping 1-inch NPS and less. Therefore, 1-inch NPS and less piping will not be selected for small-bore piping NDE examination. This sample population provides adequate indication of whether inside diameter cracking is occurring in small-bore piping.

<u>Question</u> 393

<u>LRA Section</u> n/a

<u>NRC Issue</u>

Why BWR SCC AMP has been used instead of the ISI program (per SRP-LR Section 3.1.2.2.4.1) in BFN LRA Section 3.1.2.2.4.1?

<u>TVA Response</u>

The Section 3.1.2.2.4.1 reference to the BWR Stress Corrosion Cracking Program is incorrect and should be deleted.

<u>Question</u> 394

<u>LRA Section</u> n/a

<u>NRC Issue</u>

Where in the LRA is GALL Volume 1, Table 1, Item 3.1.1.8, jet pump sensing line and reactor vessel flange detection line are addressed?

<u>TVA Response</u>

Question on where in the LRA is GALL Volume 1, Table 1, Item 3.1.1.8, jet pump sensing line and reactor vessel flange leak detection line addressed. GALL Volume 1, Table 1, Item 3.1.1.8 states that the corresponding GALL Volume 2 line items are IV.A1.1-d and IV.B1.4-d.

GALL Volume 2, Line IV.A1.1-d

The Browns Ferry top head enclosure - vessel flange leak detection line is not consistent with GALL Volume 2, Line IV.A1.1-d. The Browns Ferry components included in this line item are carbon and low alloy steel, whereas GALL Volume 2, Line IV.A1.1-d refers to stainless steel. The components included in this line item are the penetration through the carbon steel vessel flange and a short segment of carbon steel piping and fittings external to the reactor vessel. Therefore this line was not shown as corresponding to GALL Volume 1, Table 1, Item 3.1.1.8.

Currently, One-Time Inspection is listed as the aging management program for this line item. The Browns Ferry reactor vessel flange leak detection line is ASME Class 2 Equivalent and should have included the ASME Section XI Subsections IWB, IWC and IWD Inservice Inspection Program as an aging management program. ASME Section XI Subsections IWB, IWC and IWD Inservice Inspection Program will be added to this line item.

The remaining portion of the vessel flange leak detection line is stainless steel. This stainless steel piping is in the Feedwater System (003) at Browns Ferry. Aging of this piping is addressed in Table 3.4.2.3 and corresponds to GALL, Volume 2, Item C1.1-i, piping and fittings - small bore piping less than NPS 4.

GALL Volume 2, Line IV.B1.4-d

The Browns Ferry jet pump assemblies - jet pump sensing line is not consistent with GALL Volume 2, Line IV.B1.4-d. Section IV.B1 addresses BWR reactor vessel internals. The jet pump sensing lines internal to the reactor vessel have been determined to not be within the scope of license renewal for Browns Ferry. Therefore this line was not shown as corresponding to GALL Volume 1, Table 1, Item 3.1.1.8.

The jet pump instrumentation penetration is stainless steel clad carbon steel and is included with GALL Volume 2, Line IV.A1.5-a, Penetrations. External to the reactor vessel, the stainless steel jet pump sensing lines are included in GALL, Volume 2, Item C1.1-i, piping and fittings - small bore piping less than NPS 4.

FOLLOW UP NRC QUESTION:

Identify line numbers in Table 3.1.2.1 and 3.1.2.4 for the jet pump and VFLD lines.

FOLLOWUP TVA RESPONSE:

Jet Pump

- Internal to RV – not in scope
- Penetration – Table 3.1.2.1, Items 63, 64, and 65
- External to RV – Table 3.4.2.3, Items 40 and 41

RV flange leak detection line

- Penetration – Table 3.1.2.1, Item 9
- External to RV – Table 3.1.2.4, Items 88, 89, and 90

Question 395

LRA Section n/a

NRC Issue

Why 3.2.1.7 for seals in SGT system for change in properties and 3.2.1.9 for drywell and suppression chamber spray system nozzles and flow orifices for plugging with corrosion products are not referenced in ESF system tables?

TVA Response

Table 3.2.2.2, Standby Gas Treatment System includes elastomer seals in lines 7 and 8 as ductwork and lines 28 and 29 as flexible connectors.

Plugging of spray nozzles are addressed in Section 3.2.2.2.7.

Question 396

LRA Section n/a

NRC Issue

No aging effect for oil in CI, CS, Cu and SS components. If there is water contamination in the lube oil, corrosion may take place in these components. How you manage contamination in the lube oil associated with these materials?

TVA Response

Lubricating oil systems generally do not suffer appreciable degradation by cracking or loss of material since the environment is not conducive to corrosion mechanisms. In addressing the question, "Is there a potential for water contamination?" plant experience (i.e., maintenance/ operating history) is utilized as a basis for conclusions reached. The lubricating oil applications where there is no history of water contamination do not have any potential aging mechanisms. Those applications where water contamination does occur, such as the diesel generator combustion air intake filters, potential loss of material due to general, pitting, and crevice corrosion was identified as requiring management for the period of extended operation.

Question 397

LRA Section n/a

NRC Issue

Corrosion, biofouling and MIC in stainless steel and copper components in heat exchangers exposed to raw water or treated water are managed by one-time inspection program. Is there any other AMP which periodically inspects heat exchangers subject to these aging mechanisms?

TVA Response

For Table 3.1.2.4, Reactor Recirculation System, the raw water is supplied from the Raw Cooling Water System and should specify the Open-Cycle Cooling Water Program as the appropriate aging management program.

For Table 3.1.2.4, Reactor Recirculation System, the treated water refers to a self-contained cooling water system supplied with the Variable Frequency Drives. The Chemistry Control Program and the One-Time Inspection Program are the appropriate aging management programs for this cooling water system.

Question 398

LRA Section n/a

NRC Issue

Can buried piping and tanks inspection program detect crack initiation and growth due to SCC in SS buried components?

TVA Response

Table 3.2.2.7, Containment Atmosphere Dilution System (084) - Summary of Aging Management Evaluation incorrectly identifies cracking for buried stainless steel piping and fittings in line items 12 and 22 and should be deleted. This line's temperature is < 140°F and therefore is not subject to stress corrosion cracking. This is the only place in the BFN LRA where the Buried Tank and Piping Inspection Program was credited for detecting cracking. Hence, the Buried Tank and Piping Inspection Program does not detect cracking.

Question 402

LRA Section n/a

NRC Issue

The BFN LRA includes a number of entries for stainless steel components in treated water environments, including components that interface with the RCPB, for which loss of material due to corrosion is identified as an aging effect requiring management. Stress corrosion cracking is identified for some of these components and not for others. Why isn't stress-corrosion cracking identified as an aging effect requiring management for these material/environment combinations?

TVA Response

Stainless steel components have the potential for corrosion if the Chemistry Control Program is not properly implemented. However, stress corrosion cracking only requires an aging management program where the normal operating temperature is greater than 140°F.

FOLLOWUP NRC QUESTION:

Please verify that the stainless steel fittings, piping and strainers identified as RCPB components in a treated water environment in the BFN LRA Table 3.3.2.29 (Control Rod

Drive System) have a normal operating temperature less than 140F, and, therefore, are not subject to SCC. Also, please explain why stainless steel valves identified as RCPB components in the same system are subject to SCC.

FOLLOWUP TVA RESPONSE:

The AMR identifies that "The Control Rod Drive System RCPB components (valves) that interface with the RWCU System experiences normal operating temperatures in excess of 140°F." These closed valves are the only components in the Control Rod Drive System that exceed 140°F.

Question 403

LRA Section n/a

NRC Issue

The BFN LRA includes a number of Table 2 entries for components in the auxiliary systems for which there are no aging effects or aging management programs identified. However, the material/environment combinations for these components do have aging effects identified in other entries. For example, Table 3.3.2.31, row 14 shows stainless steel fittings in treated water with no aging effect or aging management program, and the next row has the same component/material/ environment with loss of material identified as an aging effect requiring management. What is the purpose of the entries showing no aging effect or aging management program?

TVA Response

The reason for the line entries that indicate no aging effects is an attempt to ensure completeness of GALL comparison. For the example given, BFN LRA, Table 3.3.2.31, rows 14 and 15 address stainless steel fittings that form a portion of containment isolation. The applicable GALL Volume 2 line item was determined to be V.C.1-b. GALL Volume 2 line item V.C.1-b lists four aging effects, pitting, crevice and microbiologically influenced corrosion and biofouling. For a treated water line, the BFN aging management review determined that microbiologically influenced corrosion and biofouling did not require management for the period of extended operation. This was documented in the aging management review as:

- Pitting corrosion – Yes
- Crevice corrosion – Yes
- Microbiologically influenced corrosion – No
- Biofouling – No

The first two aging mechanisms form the basis for BFN LRA Table 3.3.2.31, row 15. The last two are documented in BFN LRA Table 3.3.2.31, row 14 as no aging effect with Note 4 identified. Note 4 states, "Based on system design and operating history, MIC and biofouling are not applicable to the treated water portions of this system.”

FOLLOW UP NRC QUESTION:

With reference to Question 403, about "N/A", there are 2 line items that require some explanation, based on the referenced notes.

1. These are Table 3.3.2.14, row 58. Note 3 to this table says there are no aging effects identified. I don't believe this is the correct note. Please check and identify the correct note.

2. Table 3.3.2.28, row 56. Note 3 to this table says there are no aging effects identified. I don't believe this is the correct note. Please check and identify the correct note.

FOLLOW UP TVA RESPONSE:

1. Table 3.3.2.14, row 58 should refer to Notes I, 5.

2. Table 3.3.2.28, row 56 should refer to Notes I, 2.

Question 404

LRA Section n/a

NRC Issue

The BFN LRA identifies crack initiation/growth due to SCC for stainless steel components as an aging effect requiring management. In some cases, ASME ISI is credited to manage this aging effect instead of the BWR SCC Program. Examples are Table 3.3.2.21, rows 24, 54 and 93. Please clarify how the AMP was selected for this MEA combination.

TVA Response

Table 3.3.2.21, lines 24 and 54, refer to fittings and piping that are < 4” NPS. The corresponding GALL Volume 2 line item is IV.C1.1-i, which specifies the ASME Section XI Subsections IWB, IWC, and IWD Inservice Inspection Program, the Chemistry Control Program, and the One-Time Inspection Program. For fittings and piping > 4” NPS, line items 27 and 56 specify the Boiling Water Reactor Stress Corrosion Cracking Program and the Chemistry Control Program, which is consistent with IV.C1.1-f. Table 3.3.2.21, line 102 credits the Boiling Water Reactor Stress Corrosion Cracking Program and the Chemistry Control Program for aging management of Valves-RCPB which is consistent with IV.C1.3-c. Note that the Boiling Water Reactor Stress Corrosion Cracking Program invokes the ASME Section XI Subsections IWB, IWC, and IWD Inservice Inspection Program for inspection and flaw evaluation to monitor intergranular stress corrosion cracking.

Table 3.3.2.21, lines 20, 49, and 93, for non-reactor coolant pressure boundary fittings, piping, and valves, respectfully, incorrectly listed the ASME Section XI Subsections IWB, IWC, and IWD Inservice Inspection Program and/or Boiling Water Reactor Stress Corrosion Cracking Program. The correct aging management programs for lines 20, 49, and 93 are the Chemistry Control Program, and the One-Time Inspection Program.

Question 413

LRA Section n/a

NRC Issue

The applicant in LRA Table 3.4.2.3 Feed Water System, item 11, for component type fittings (MEAP No. VIII.D2.1-b), material SS in Air/Gas internal moisture environment indicates a non-GALL aging effect Crack Initiation a/growth due to fatigue. The applicant proposes one time inspection (B.2.1.29) to mitigate the AE. Since there are No precedents cited, project staff would like some amplification on the identified aging effect from the O/E perspective and how the applicant proposes to mitigate it?

TVA Response

This line item is referring to the area between the two isolation valves on Feedwater System vent and drain lines. This small segment of piping is exposed to feedwater flow when the valves are open and has trapped air with varying amount of feedwater based on how the valves are closed, i.e., the sequence and time between closing the valves. The safety consequences for this short segment of piping failing are none existent as this line is downstream of a closed isolation valve. However, for completeness, BFN will perform some inspections to verify these lines are not degrading due to loss of material using the One-Time Inspection Program. Crack initiation due to stress corrosion cracking is not applicable and should be deleted from this material/environment combination for the Feedwater System. This question is similar to Question 304 on the Condensate System.

Question 429

LRA Section Table 3.3.2.9

NRC Issue

Table 3.3.2.9, Line Item 138 - Justify the determination that no aging effects requiring management exist for heat exchangers in an outside air environment.

TVA Response

The cooling coils identified in an outside environment are in the Freon cycle and the air flow over the coils is to cool the Freon. Therefore, condensation on the coils will not occur and loss of material is not identified as an aging mechanism requiring management for the period of extended operation.

Air side fouling of cooling coils that have no condensation mechanism is only a problem for fin type heat exchangers. Therefore, fouling is not identified as an aging mechanism requiring management for the period of extended operation.

<u>Question</u> 430

<u>LRA Section</u> Table 3.3.2.1

<u>NRC Issue</u>

Table 3.3.2.1, Line Items 3, 4, 10, 11, 17, 21, and 26 – Justify why One-Time Inspection is sufficient for carbon steel/cast iron in a moist air environment.

<u>TVA Response</u>

Table 3.3.2.1, Auxiliary Boiler System, identifies loss of material in air/gas with One-Time Inspection identified as the aging management program. The air/gas components in the Auxiliary Boiler System were exposed to secondary quality water or steam that has been isolated by the lay-up of the auxiliary boilers. The portions of the system that now contain air/gas are isolated and there is no mechanism for introducing contaminates or additional oxygen. Since the portions of the Auxiliary Boiler System exposed to air/gas was originally chemistry controlled, the potential for corrosion is low. The One-Time Inspection Program will verify this by performing a sampling inspection. If corrosion is detected that indicates that operation during the period of extended operations may be affected, then additional inspections and corrective actions are required by the One-Time Inspection Program.

<u>Question</u> 431

<u>LRA Section</u> Table 3.3.2.9

<u>NRC Issue</u>

Table 3.3.2.9, line Items 97, 98, 106, 109, 111, 158, and 159 – Provide the technical basis for One-Time Inspection for heat exchangers and heaters one items where more than just general corrosion is identified.

<u>TVA Response</u>

Table 3.3.2.9, Heating, Ventilation, and Air Conditioning, identifies loss of material in an air/gas environment with One-Time Inspection identified as the aging management program. The air/gas environment components in the Heating, Ventilation, and Air Conditioning are were exposed heated and cooled circulated air. Loss of material is consistent with the GALL, although the GALL identifies only general corrosion. Based on the potential for water accumulation on or in the area of the cooling coils, addition potential aging mechanisms were identified for BFN. The actual experience based on a review of work orders and PERs demonstrates that loss of material has not been a issue with this system. In particular, no instances of pitting, crevice, or galvanic corrosion were identified in this review. The One-Time Inspection Program will verify this by performing a sampling inspection. If corrosion is detected that indicates that operation during the period of extended operations may be affected, then additional inspections and corrective actions are required by the One-Time Inspection Program.

Question 432

LRA Section Table 3.3.2.2

NRC Issue

Table 3.3.2.2, Line items 3, 4, 5, 14, 15, 16, 45, 46, 47, 86, 87, 88, 106, 107, 113, and 114 - Justify the determination that no aging effects requiring management.

TVA Response

Table 3.3.2.2, Fuel Oil System, contains components that are exposed to a fuel oil vapor environment. This fuel oil vapor environment protects the component surfaces and prevents internal corrosion. The proper precedence for this conclusion is included in St. Lucie application Table 3.3-4 and the St. Lucie SER, Section 3.3.4.2.1

Question 433

LRA Section Tables 3.3.2.2, 3.3.2.3, 3.3.20, 3.3.2.25, and 3.3.2.26

NRC Issue

Table 3.3.2.2, Line items 7, 19, 49, and 89; Table 3.3.2.3, Line items35 and 42; Table 3.3.2.20, Line items 9 and 38; Table 3.3.2.25, Line Items 5 and 24; and Table 3.3.2.26, Line items 15 and 33 - What if adjacent accessible area shows degradation?

TVA Response

No aging effects are identified for embedded/encased components. If excessive corrosion that could prevent the performance of the intended functions during the period of extended operation was detected in the inside or outside air environments adjacent to the embedded/encased portions, then corrective actions would be taken to restore the component, including the embedded/encased portions if this is determined to be necessary.

Question 434

LRA Section Table 3.3.2.9

NRC Issue

Table 3.3.2.9, Line items 131 and 132 - Justify the determination that no aging effects requiring management exist for heat exchangers in an air/gas environment.

TVA Response

Table 3.3.2.9, line items 131 and 132 are referring to the Freon side of the cooling coil and correctly identify no aging effects. The material should reference Freon. Note that Table 3.3.2.9, line items 127 and 128 incorrectly reference Freon in the materials description. These items are for the external of cooling coils and correctly identify loss of material.

Question 435

LRA Section Table 3.3.2.9

NRC Issue

Table 3.3.2.9, Line item 153 - Justify why One-Time Inspection is sufficient for heat exchangers.

TVA Response

Table 3.3.2.9, Heating, Ventilation, and Air Conditioning, identifies the potential for fouling as the aging effect requiring management. The air/gas environment the cooling coils are exposed to is heated and cooled circulated air. The actual plant experience based on a review of work orders and PERs demonstrates that fouling has not been a issue with this system. The One-Time Inspection Program will verify this by performing a sampling inspection. If fouling is detected that indicates that operation during the period of extended operations may be affected, then additional inspections and corrective actions are required by the One-Time Inspection Program.

Question 436

LRA Section Tables 3.3.2.7 and 3.3.2.29

NRC Issue

Table 3.3.2.7, Line items 13, 15, 21, 24 31, and34; and Table 3.3.2.9, Line items 69, 71, 211, and 241 - Why is One-Time Inspection sufficient for copper alloys in a raw water environment?

TVA Response

The raw water identified in this line item is potable (city) with actual chemistry that is much milder than expected for raw water. Therefore, loss of material effecting component operability during the period of extended operation is not expected. The One-Time Inspection Program will verify this by performing a sampling inspection. If corrosion is detected that indicates that operation during the period of extended operations may be affected, then additional inspections and corrective actions are required by the One-Time Inspection Program.

Question 437

LRA Section Table 3.3.2.10

NRC Issue

Table 3.3.2.10, Line items16, 37, and 43 – Is the Ni-5b precedence note correct.

TVA Response

The correct precedence note is Ni-5a.

Question 438

LRA Section Table 3.3.2.16

NRC Issue

Table 3.3.2.16, Line items 6, 13, 14, 18, and 19 - Why is One-Time Inspection sufficient for nickel alloys in a raw water environment?

TVA Response

The raw water referred to in this line item is a diluted raw water chemical treatment solution. The diluted chemicals in these nickel alloy components minimize any aging effects that potentially affect component operability during the period of extended operation. The One-Time Inspection Program will verify this by performing a sampling inspection. If corrosion is detected that indicates that operation during the period of extended operations may be affected, then additional inspections and corrective actions are required by the One-Time Inspection Program.

Question 439

LRA Section Table 3.3.2.16

NRC Issue

Table 3.3.2.16, Line items 7, 15, and 22 - Justify the determination that no aging effects requiring management exist for polymer in a raw water environment.

TVA Response

The polymer referred to in Table 3.3.2.16 is the internal surface of polypropylene lined carbon steel components. The BFN LRA does not credit the lining for prevention of corrosion and this material/environment combination should be deleted.

FOLLOWUP NRC QUESTION:

Please clarify what is meant by not crediting the line for prevention of corrosion.

FOLLOWUP TVA RESPONSE:

This means that we assume the polymer lining fails and provides no protection for the underlying carbon steel.

Question 440

LRA Section Table 3.3.2.9

NRC Issue

Table 3.3.2.9, Line items 156 and 157 - Justify using One-Time Inspection for detecting the cracking aging effect.

TVA Response

Cracking was inappropriately identified for raw water and should be deleted.

Question 441

LRA Section Table 3.3.2.1

NRC Issue

Table 3.3.2.1, Line item 30 – This line item identifies One-Time Inspection, is this the correct aging management program?

TVA Response

The correct aging management program is the Selective Leaching Program.

Question 442

LRA Section Table 3.3.2.9

NRC Issue

Table 3.3.2.9, Line items 156 and 157 - Justify using One-Time Inspection for heat exchangers.

TVA Response

The raw water referred to in this line item is actually potable (city) water. The actual chemistry of potable water is milder than raw water. Therefore, loss of material and fouling potentially effecting component operability during the period of extended operation is not expected. The One-Time Inspection Program will verify this by performing a sampling inspection. If corrosion or fouling is detected that indicates that operation during the period of extended operations may be affected, then additional inspections and corrective actions are required by the One-Time Inspection Program.